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The development, field testing, and implementation of a model high school physical fitness program

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University of Hawaii, 1993

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THE DEVELOPMENT, FIELD TESTING, AND IMPLEMENTATION
OF A MODEL HIGH SCHOOL PHYSICAL FITNESS PROGRAM

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF EDUCATION

IN

CURRICULUM AND INSTRUCTION

AUGUST 1993

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iii
ACKNOWLEDGEMENTS

A project for this nature cannot be accomplished without the assistance of others. I wish to acknowledge those without whose help this project could not have been completed.

I wish to first acknowledge the Missionary Training Center of the Church of Jesus Christ of Latter Day Saints for allowing the field testing of the Timed-X program. The circumstances and climate at the MTC provided exceptional conditions for a field test of this nature. Secondly, I wish to thank Pita Birati and Harry Wright of the Moroni High School in Kiribati for the trust and confidence they showed in me by allowing the implementation of the Timed-X program at their school.

I also wish to give special thanks to the members of my committee. They have provided me encouragement and counsel at each crucial point throughout the doctoral process. They believed in me and in this project from the beginning.

Finally, I wish to acknowledge the love and support of my wife Lorrie, and children Tara, Lincoln, Dillon, Taylor. They have in this, as in all things in my life, been the wind beneath my wings.
ABSTRACT

Timed-X is a physical fitness program which was developed, field tested, and implemented for high school use. It was developed to provide a health-related component for physical education classes that was an equally appropriate and challenging exercise stimulus to participants on all fitness levels. The program, which lasts for between 20-25 minutes (depending on the length of warm-up and cool-down), is based on 10 second bursts of high intensity exercise followed by 10 second periods of rest. Each exercise is performed for three 10 second periods followed by the selection and starting of another exercise. With only a ten second rest period between changes of exercise, the entire exercise portion of the program should last for a recommended 15 minutes and include 15 different exercises. Exercises are rotated between upper, mid, and lower body activities to avoid local fatigue. The entire program, from warm-up through cool-down, is contained on an audio cassette tape.

An eight week field test was conducted on 60 nineteen year-old volunteers who were randomly divided into three treatment groups. One group jogged for the 15 minute duration of the Timed-X program while a control group participated in recreational activities. Pre- and post-tests were administered in the 1.5 mile run and body composition (skinfold). An analysis of variance was run on the results of the tests and significant differences were found at the .05 level between the jogging and Timed-x groups and the control groups. No significant differences were found between the jogging and Timed-X groups at the .05 level.
The Timed-X program was implemented at the Moroni High School in the Central Pacific nation of Kiribati. School officials determined the program a success based on results in interschool competition.

Diagrams and photographs of warm-up (stretching), upper, mid, and lower body exercises are included.
TABLE OF CONTENTS

Acknowledgements ......................................................... iv
Abstract ....................................................................... v
List of Tables ................................................................. ix
List of Figures ................................................................. x

Chapter I: Introduction .................................................... 1
  Statement of the Problem .............................................. 1
  Purpose of the Study ................................................... 4
  Research Question ...................................................... 5
  Hypothesis .................................................................. 5
  Delimitations .............................................................. 6
  Limitations ................................................................. 7
  Definition of Terms ..................................................... 7

CHAPTER II: Review of Related Literature .......................... 10
  Recent Focus Shifts in Physical Fitness ............................ 10
  Benefits of Physical Fitness .......................................... 13
  Examples of Exercise Programs Used to Achieve Health-Related
    Physical Fitness ......................................................... 15
    Circuit Training ......................................................... 15
    Calisthenics ............................................................... 20
    Interval Training ....................................................... 23
  Summary of Physical Fitness Programs ............................ 31
  Selected Current Physical Education Curricula ................. 31

CHAPTER III: Procedures .................................................. 35
  Development ................................................................ 35
  Field Testing ............................................................... 44
    Subjects ..................................................................... 45
    Determining Experimental and Control Groups ............... 46
    Testing Procedures ................................................... 46
      1.5 Mile Run .......................................................... 46
      Body Composition .................................................. 47
    Equipment .................................................................. 48
    Statistical Model ....................................................... 48
  Implementation ............................................................ 48
    A Brief History ........................................................ 49
    The Growth of Education ............................................ 50
    The Moroni Community School .................................... 52
Implementation Process of the Timed-X Physical Fitness
  Program .......................................................... 52
  Week One ......................................................... 57
  Week Two ........................................................ 62
  Week Three ....................................................... 66
  Committee Concerns ............................................. 70

CHAPTER IV: Presentation and Analysis of Data .................. 74
  Field Testing ...................................................... 74
  1.5 Mile Run ..................................................... 75
  Body Composition ............................................... 83
  Summary .......................................................... 89
  Implementation ................................................... 92

CHAPTER V: Summary, Conclusions, and Recommendations ....... 94
  Appendix A: NASPE Recommendations .......................... 100
  Appendix B: Flexibility Exercise Diagrams .................... 101
  Appendix C: Flexibility Exercise Pictures ..................... 121
  Appendix D: Timed-X: Upper body exercise diagrams ......... 146
  Appendix E: Timed-X: Mid body exercise diagrams .......... 149
  Appendix F: Timed-X: Lower body exercise diagrams ....... 156
  Appendix G: Timed-X: Upper body exercise pictures ......... 169
  Appendix H: Timed-X: Mid body exercise pictures .......... 173
  Appendix I: Timed-X: Lower body exercise pictures ......... 180
  Appendix J: Cooper's Fitness Categories ....................... 194

Bibliography ................................................................ 195
LIST OF TABLES

Table | Page
-----|-----
1. Pre- and post-test results of the 1.5 mile run for the Timed-X test-group | 76
2. Pre- and post-test results of the 1.5 mile run for the jogging test-group | 78
3. Pre- and post-test results of the 1.5 mile run for the control group | 80
4. Analysis of Variance between the pre- and post-test differences (delta scores) for the 1.5 mile run between the three groups | 82
5. 1.5 mile running time prior to and post 8 weeks of treatment | 83
6. Pre- and post-test results of the body composition evaluation for the Timed-X test-group | 84
7. Pre- and post-test results of the body composition evaluation for the jogging test-group | 86
8. Pre- and post-test results of the body composition evaluation for the control group | 88
9. Analysis of Variance between the pre- and post-test differences (delta scores) for the body composition (skinfold) test between the three groups | 90
10. Body composition (skinfold) measurements prior to and post 8 weeks of treatment | 91
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A Comparison of changes in fitness categories for pre- and post-test in the 1.5 mile run for the three groups</td>
<td>77</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

Statement of the Problem

The need for an individually challenging physical fitness program, which could be used by schools of varying financial resources and facilities, has long been of interest to me. I have observed the gradual decline in youth fitness levels (consistent with those reported by Updyke and Willett) (72) and have seen societal changes which support inactivity. As a high school student I was considered an outstanding athlete and often felt that physical education classes, which were seldom challenging to me, were geared toward the average student. In my high school during a typical physical education fitness workout some students could not achieve the minimum level, most could complete the workout, and some of us were unchallenged by the workout. I experienced the frustration and disappointment of a program that failed to consider the vastly different needs of students. I believe that if a program could be developed that would equally challenge all participants it would be possible to change the downward direction of physical fitness levels and resulting health risks while motivating both the physically fit and the unconditioned student. The decline in physical fitness and health has resulted, in part, from the choices of a changing society. Today’s youth eat too much fat, sit in front of the television or video games for hours on end, and ride in a car instead of walking or riding a bicycle even over short distances. Our choices have taken us to the point that the Surgeon General has ranked obesity as the second leading cause of preventable death in the United States. Research indicates that children are becoming obese at an earlier age and that the degree of obesity has
increased. Not only has obesity increased up to 54% among adolescents but now 80% of obese adolescents become obese adults. (18) Closely related to this seemingly epidemic rise of obesity are low fitness levels. Updyke and Willett (72) conducted research that shows a 10% decline in the aerobic fitness levels of children as measured by distance runs. In a nationwide survey reported in the Journal of the American Medical Association, only 36% of children in grades one through 12 participate in a daily exercise program. (45)

The American Alliance of Health Physical Education Recreation and Dance (AAHPERD) has developed an excellent program called PHYSICAL BEST. It was developed as a resource and guideline for teachers to educate and expose children to positive health-related lifestyle options. The program is designed to encourage caloric expenditure through increased emphasis on lifelong aerobic activities. As good as PHYSICAL BEST and other programs are, they do not overcome the need of providing an equal and fair fitness challenge for all students. Let me explain what I mean. If we go out to a restaurant with Mary Lou Retton and William "the Refrigerator" Perry and they are both brought identical items from the menu, right down to the same size piece of parsley next to the five small white round potatoes, that may be an example of equal portions, but it is not fair. The caloric needs of a 350 pound NFL lineman are much greater than those of a 100 pound gymnast. In the same way, if an athlete and an overweight non-conditioned student, both participating in a high school physical education class, are asked to do twenty push-ups, the athlete is given nothing more than a warm-up while the overweight non-conditioned student
must roll over and do a sit-up just to get off the ground even if he does complete the
twenty push-ups. The twenty push-up assignment may be equal but it is far from
being fair and certainly does not even approach meeting the two students' varied
needs. For the purpose of this study, the term "fair" is defined as, "being
physiologically appropriate for the needs of an individual student".

The lack of an equal and fair physical fitness program has done much to
diminish physical education in the eyes of participants for decades. The athlete has,
in some instances, considered physical education class a time to rest, an easy "A," an
opportunity to show off, and a chance to put down other students. The overweight or
poorly coordinated student has, on occasion, been embarrassed, threatened, chosen
last for games or activities, and made fun of in the showers or locker rooms. The
results of these experiences have, in some instances, added arrogance to an already
confident group and pushed away from movement and activity the very group who
needs exercise the most. In some cases parents, in an attempt to protect their child
from social and emotional stress, have written invalid excuses for non-participation or
sought for exceptions to the required physical education class. Although the physical
education requirement varies from state to state, there has been a consistent drop in
the requirement for graduation. For example, in the state where I grew up, Utah, the
requirement was three years of physical education; it is now two. In some states,
there is no requirement, and in Hawaii, for example, the requirement is just one year.
One Hawaii high school (Kahuku), and there may be others, allows marching band to
meet the physical education requirement for graduation. I believe this move away
from physical education in our schools, during a period of increased fitness awareness nationwide, is, in part, a result of physical education curriculum deficiencies.

**Purpose of the Study**

The purpose of this study was to develop, field test, and implement a model high school physical fitness program. Therefore, it includes three different yet related areas. **First: Development.** There is an urgent need for a high school physical fitness program, based on an equal and fair premise, which could produce an increase in cardiovascular endurance while decreasing body fat. The program should meet the needs of schools with respect to time, staffing, facility, and financial constraints. **Second: Field Testing.** The program must be tested to validate the fitness components relative to current standards. Cardiovascular endurance and body composition should be evaluated during the field test. **Third: Implementation.** A trial period, in an actual high school, must take place to work out the bugs. I realize that whatever type of program is developed, field tested, and implemented, it is only the beginning. Modifications and amplifications will surely take place in refining a program capable of meeting the fitness needs of all high school students. It is hoped that the program developed for this study may be a framework from which to find an acceptable solution to the challenges facing high school fitness within the physical education classroom. As a result of this study more attention may be given to the direction of curriculum development within high school physical education.
Research Question

The purpose of field testing the developed model high school physical fitness program was to determine whether taking part in the program benefitted the participants with respect to selected health-related fitness components. It was believed that the developed model program, Timed-X, would increase cardiovascular endurance and decrease body fat. The 1.5 mile run, to determine cardiovascular endurance, and a skinfold test, to determine body fat, were chosen for pre- and post-tests in evaluating those health-related fitness components. Since jogging is a widely accepted form of exercise, for increasing cardiovascular endurance and decreasing body fat, a jogging test group was selected against which the program (Timed-X) test group would be compared. A control group, allowed recreational activities, also participated for the same number of minutes each day during the eight-week test period. If the Timed-X test group was able to produce similar results with those of jogging, it would be justified, from a health-related standpoint, to implement the model program into an actual high school setting.

Hypothesis (relating to the field test)

Null--There were no significant differences on the 1.5 mile run time and body composition between the Timed-X and jogging groups.

Alternate--There were significant differences on the 1.5 mile time and body composition results between the Timed-X and jogging groups.

Null--There were no significant differences on the 1.5 mile run time and body composition between the Timed-X and control groups.
Alternate—There were significant differences on the 1.5 mile run time and body composition between Timed-X and control groups.

**Delimitations**

The following delimitations apply to this study:

1. The program was developed for high school use.
2. The program was developed for indoor use with outdoor, good weather capability.
3. The program was developed to affect the fitness components, cardiovascular endurance and body composition.
4. The program was developed to be an equal and fair exercise challenge for all participating students.
5. The program was field tested for cardiovascular endurance and body composition changes.
6. The subjects for the field test were healthy nineteen year old LDS missionaries.
7. The field test lasted eight weeks.
8. The implementation was conducted at the Moroni High School in Tarawa, Kiribati.
9. The implementation was conducted in (British education levels) Forms I, II, and III only.
Limitations

The following limitations apply to this study:

1. The program was created from the knowledge, experience, and research of the author.

2. During the field testing of the program, control of the subjects outside activities was impossible.

3. During the field testing of the program, motivation of subjects and intensity of performance could not be controlled.

4. During the implementation of the program, policies and procedures of the physical education department and the administration of the Moroni High School set parameters.

5. During the implementation of the program, the existing facilities at the Moroni High School were used.

6. During the implementation of the program, the enthusiasm and motivation of the physical education faculty and staff could not be controlled.

Definition of Terms

**Adenosine triphosphate (ATP).** A complex chemical compound that is formed with the energy released from food and that is stored in all cells, particularly muscle cells. Only with the energy released from the breakdown of this compound can the cell perform work.

**Aerobic.** In the presence of oxygen.
**Alactacid oxygen debt.** That portion of oxygen used to resynthesize and restore ATP and creatinephosphate in muscle immediately following exercise (i.e. during recovery).

**Anaerobic glycolysis.** The incomplete chemical breakdown of carbohydrate. The anaerobic reactions in this breakdown release energy for the manufacture of ATP as they produce lactic acid. Anaerobic glycolysis is sometimes referred to as the lactic acid system.

**ATP-CP System.** An anaerobic energy system in which ATP is manufactured when creatinephosphate (PC) is broken down. This system represents the most rapidly available source of ATP for use by muscle. Activities performed at maximum intensity in a period of 10 seconds or less derive energy (ATP) from this system.

**Body Composition.** The component parts of the body--mainly fat and fat-free weight.

**Cardiovascular endurance.** The ability of the lungs, heart, and blood vessels to deliver adequate amounts of oxygen to the cells to meet the demands of prolonged (aerobic) physical activity.

**Circuit training.** A conditioning program consisting of a number of exercises performed at "stations." Usually, a given exercise is performed at a station within a specified time; then the athlete moves to the next station, with its own particular exercise and specified time, then to the next station, and so on.
Interval training. An exercise program in which the body is subjected to short but regularly repeated periods of work stress interspersed with adequate periods of relief.

Lactic acid. A fatiguing metabolite of the lactic acid system resulting from the incomplete breakdown of carbohydrate.

Maximal oxygen uptake (Max VO$_2$). The maximal amount of oxygen that the body is able to utilize per minute of physical activity, commonly expressed in ml/kg/min. A good indicator of aerobic capacity.

Missionary Training Center. A language and cultural education facility owned and operated by The Church of Jesus Christ of Latter-Day Saints.

Oxygen debt. The amount of oxygen consumed during recovery from exercise above that ordinarily consumed at rest in the same time period. There is a rapid component (alactacid) and a slow component (lactacid).

Phosphagen. Compounds that yield inorganic phosphate and release energy when broken down. ATP and PC are phosphagens.

Sarcoplasm. The protoplasm of muscle cells.

TCA (Krebs) cycle. A series of chemical reactions occurring in mitochondria, in which carbon dioxide is produced and hydrogen ions and electrons are removed from carbon atoms (oxidation).
CHAPTER II

REVIEW OF RELATED LITERATURE

Much research has been done concerning the health related benefits of exercise. These benefits, considered significant by physical educators, have assisted in the establishment of criteria essential in high school physical education programs. The purpose of this chapter is to review selected literature on physical fitness as a major component of the physical education curriculum, give examples of exercise programs used to achieve that component, and show limitations of selected current physical education curricula.

Recent Focus Shifts in Physical Fitness

Physical fitness has long been defined in broad terms and has included an assortment of components. During the past decade a separation between "motor fitness" and "health-related fitness" has narrowed the uncertainty and assisted in clarifying physical fitness. While neuromotor fitness refers to physical abilities that relate primarily to athletic performance, health-related fitness focuses on disease prevention, functional capacity, and the promotion of sound physical activity habits. Within the area of health-related physical fitness, research indicates that health status in any of the selected components is related to the level of participation in that component. According to Gisolfi and Lamb (36) the components for health-related fitness are cardiorespiratory endurance, body composition, muscular strength/endurance (abdominal and upper body), and flexibility (low back/hamstring).
They state the rationale as benefits associated with maintenance of each component at an acceptable level are as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>Cardiorespiratory</td>
<td>Enhanced physical working capacity</td>
</tr>
<tr>
<td>Endurance</td>
<td>Reduced fatigue</td>
</tr>
<tr>
<td></td>
<td>Reduced risk of coronary heart disease</td>
</tr>
<tr>
<td>Body Composition</td>
<td>Reduced risk of hypertension, coronary heart disease, and diabetes</td>
</tr>
<tr>
<td>Muscular Strength</td>
<td>Enhanced functional capacity - lifting carrying</td>
</tr>
<tr>
<td></td>
<td>Reduced risk of low back pain</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Enhanced functional capacity - bending twisting</td>
</tr>
<tr>
<td></td>
<td>Reduced risk of low back pain</td>
</tr>
</tbody>
</table>

These health-related fitness components demonstrate a directional change in emphasis from earlier motor fitness components. The trend from motor fitness to health-related fitness can be seen in the nationally sponsored AAHPERD Youth Fitness Tests conducted during the thirty year period from 1958-1988. Fitness components in 1958 included cardiorespiratory endurance, muscular strength & endurance, anaerobic power, speed, agility, and motor skill. The 1958 test did not include flexibility or body composition. By 1975, expanded options were presented in the cardiorespiratory category to include the 1-mile or 9-minute run and the 1.5-mile or 12-minute run, depending upon age. Although the validity has been questioned since the 1958 instrument, the 600-yard run/walk, is still used as an alternative. Sit-
ups were modified in 1975 to require the bent knee-arms across chest method with a maximum number in 1-minute, compared to the 1958-74 standard of a maximum number, no time limit, straight legs, hands behind head, and elbows alternately touching opposite knees. Motor fitness components of anaerobic power, speed, and agility were still test items in 1975, although the motor skill of throwing a softball for distance was eliminated for the first time that year. As of 1975 the health-related fitness components of flexibility and body composition were still not an item in the AAHPER Youth Fitness Test bank. In 1980, the name of the instrument was changed to the AAHPERD Health-Related Physical Fitness Test and the test items for flexibility and body composition were added. Also in 1980, testing for the motor fitness components of anaerobic power, speed, and agility were dropped. In 1988, the name of the instrument was again changed. It was called the AAHPERD Physical Best Program. The fitness components and test items remained the same (36).

Other agencies have adopted instruments to evaluate physical fitness. There is a marked consistency among them in fitness components with respect to health-related fitness. The AAHPERD Physical Best Program was compared to instruments developed by Fitness Gram, Presidents’s Challenge, Fit Youth Today, National Children and Youth Fitness Studies I &II, and the International Council of Sport Science and Physical Education (ICSSPE) (36). Some of those instruments still included limited testing in selected motor fitness components.

All agencies included the health-related fitness components of cardiorespiratory endurance, and muscular strength and endurance. All but the ICSSPE included
flexibility. The ICSSPE and the President’s Challenge did not include body composition. Interestingly, it was only the ICSSPE and the President’s Challenge that required testing in motor fitness components. The ICSSPE conducted testing in the 20m dash and the standing long jump and the President’s Challenge in the shuttle run. Consensus among the agencies seems to be strong for those components of health-related fitness.

Benefits of Physical Fitness

The trend toward health-related fitness programs has arisen from a plethora of research indicating the disease preventive potential inherent in those programs. Cardiovascular diseases (CVD) are directly related to nearly 50% of deaths in the United States and indirectly related to a large percentage of additional deaths. Heart disease, stroke, and related blood vessel disorders combined to kill nearly 1 million Americans in 1988. This figure represents more deaths than were caused by cancer, accidents, pneumonia, lung disease, influenza, and all other causes combined (64). In spite of these staggering statistics according to the 1991 Heart and Stroke Facts, between 1978 and 1988, death rates from CVD declined by 22.8% (5). Among the risk factors for CVD published by the American Heart Association are elevated blood pressure, obesity, cigarette smoking, inactivity, hyperglycemia, and excessive emotional stress (16).

Prevention or reduction of the risks for CVD can be seen by changing certain patterns of behavior (23). Perhaps too often, life-style modification is regarded as a theoretical rather than practical concept. According to the Journal of the American
Medical Association physical exercise levels can be modified to have direct influence on other life-style elements: 1) reducing the desire to smoke, 2) favoring reduction or avoidance of obesity, 3) helping to control blood pressure, 4) countering dietary impulses and psychological stresses, and 5) inducing alteration of unfavorable environmental or family circumstances (62). In a 16 year longevity study among Harvard male alumni, exercise diminished the likelihood of coronary heart disease. The research states that although the types and amount of exercise likely to achieve optimum cardiovascular health are uncertain, coronary heart disease incidence is reduced substantially among alumni who expend 2,000+ kilocalories per week in walking, climbing, and sports play (61). In this study many causes such as smoking, hypertension, etc. were evaluated. A decline in death rates with increasing activity was seen for each cause of death but was strongest and most significant in relation to cardiovascular and respiratory diseases. Cooper (16) conducted a study where five age-adjusted cardiorespiratory fitness categories were determined from treadmill times. A consistent inverse relationship among physical fitness categories and resting heart rate, body weight, percent body fat, serum levels of cholesterol and triglycerides, glucose, and systolic blood pressure, were observed. Forced vital capacity was directly related to levels of fitness. In a study conducted on the relationship of obesity and physical fitness to cardiopulmonary and metabolic function, it was found that although 32% of the variation in pulmonary function could be accounted for by age, physical inactivity and obesity made significant contributions
to the poorer performance of these systems (54). These results, although cross-sectional, imply that physical fitness is related to lower coronary risk factors.

Examples of Exercise Programs Used to Achieve Health-Related Physical Fitness

This review will focus its attention on exercise programs which consist of circuit training, calisthenics, and interval training principles. The review will further discuss the efficacy of "high intensity exercise" as a significant factor in obtaining a health-related fitness response from selected fitness training regimens.

Circuit Training

An early form of circuit training was introduced by The United States Department of the Army in a conditioning drill manual known as "The Army Dozen" (65). This program, initiated in 1953, was intended to prepare the troops for the strength and endurance necessary in combat. The program began with each of 12 exercises being repeated for five repetitions. Beginning on the sixth day, an additional repetition was added to each exercise daily until a total of 12 repetitions could be performed for each of the 12 exercises. Therefore, daily total exercise repetitions were increased from 60 at the beginning to 144 at the end of the two-week training.

As the program continued, rest periods were shortened between exercises until the entire 144 repetitions of the exercises were completed within a time period of 15 minutes. Since all soldiers performed the identical number of exercises and repetitions for each exercise, this program did not take individual fitness levels into consideration. Consequently, those in the best condition would not have reached
maximum training intensity, and those needing the most conditioning improvement would have experienced high degrees of exertion.

An offshoot from early calisthenics programs (65, 72) was a conditioning program called circuit training. The basic philosophy of the circuit training is for the participant to advance or move from one designated location or station to another. Each station emphasizes a specific exercise or fitness component. The length of time allowed for the completion at each station and the number of recommended repetitions per exercise, if applicable, also are specified.

In 1961, Morgan and Adamson (53) clarified the three goals for the circuit training program: 1) to develop muscular and circulo-respiratory fitness, 2) to utilize the principle of progressive loading, and 3) to allow a large number of performers to participate at the same time. These goals can be accomplished by employing a circuit of consecutively numbered exercises. Participants monitor their own workout by comparing their progress against a clock. Therefore, individualization in the program is the major advantage of circuit training. Selection of exercises could include those focusing on the muscles of the legs, back, abdomen, arms and shoulders. A number of stations can be set up for all or some of the muscle groups depending upon circumstance.

Circuit training has been used in a wide variety of fitness programs and by those having a wide range of fitness levels from world class athletes to the general exercise enthusiast. During the sixties, the U.S. Ski Team followed a program of circuit training developed by Beattie (10) consisting of five exercises. The number of
repetitions for each of the five exercises was determined by taking half of the total number of repetitions that could be performed during one maximal effort. The five exercises were completed quickly with the entire circuit repeated three times. The success of this training resulted from the maximal effort received by challenging the skiers to push themselves to the limit. Although developed for world class athletes, Beattie's program was recommended for less competitive skiers based on the success of the U.S. Ski Team between 1961-1969.

In 1977, Reider and Marshall (70) also recommended circuit training as a means to develop and improve endurance among skiers. Their recommendations, with the maximal effort of the performers, continued the trend toward high intensity conditioning. In addition, other studies have validated the certainty of the improved condition of selected fitness components through circuit training (12, 34, 43, 44, 51, 58, 68, 75, 77, 87). For example, Howell (44) found significant improvement in fitness levels, tested with a Harvard Step Test, following a circuit training program. Piorkowski (68) found circuit training to be an effective means for improving the fitness levels of patients recovering from alcohol abuse. Maroc (51) compared two different techniques in circuit training and recorded a "total fitness" improvement among subjects tested. Sorani (79) agreed with the total fitness concept and postulated that circuit training is at its productive peak when employed by the non-trained general population. He stated that in order for circuit training to be appropriate for everyone, the program must be initiated at low levels of intensity. Progression on the circuit should proceed slowly and result from a gradual decrease
of time required to complete the circuit, or by a gradual increase of workload, or a combination of both.

Weight lifters have long used a circuit training method for strength development (59, 60). Circuit training in weight lifting incorporates the same principles theorized by Sorani (79) without the limited recommendation for beginners. The program is based on progressively increasing the repetitions and/or intensity and/or resistance at each exercise station while decreasing the rest periods between exercises.

Allen (2) found significant strength gains in young men who participated in a circuit weight training program. However, the subjects’ cardiovascular endurance did not significantly improve in this study. Wilmore (78) conducted a similar study using young female subjects. In addition to strength gains, maximum oxygen uptake (max VO₂) also increased, which suggested that the circuit weight training may contain a significant aerobic component.

Payne and Silvester (63) studied an exercise program that lasted 18-36 minutes. The program consisted in a three-station-rotation-circuit weight training course. Exercise at each station (15 seconds) was followed by a 1-minute jog. This sequence was continued throughout the entire workout. The results of this study indicated that in addition to significant strength improvement, the aerobic capacity of the subjects also increased 15-17%.

Gettman and Pollack (34), in a thorough review of the literature, concluded that circuit weight training can improve cardiorespiratory endurance and muscular
strength, as well as a change in body composition, but sessions must last 25 to 30 minutes. Their review indicated that a 5% increase in aerobic capacity can result, depending on their routine, from circuit weight training as compared to 15 to 25% improvement from other types of aerobic exercise. Sobey (78) found similar results in his research examining "aerobic weight training."

Cooper (16) has studied a "supercircuit." In this modified circuit weight training program, rest periods were substituted with running in place or running around the gymnasium for 80 to 160 yards between stations. Results of this study showed a 5-12% increase in aerobic capacity and an 18-23% increase in strength, when compared to a standard circuit weight training program. As early as 1959 Adamson (1) concluded that the critical variable affecting the limits of performance hinged on the amount of work done per second during a circuit training exercise bout. He suggested that the principle of progressive loading appeared to provide the solution for the problem of work quality control by increased work rate (intensity).

In recent years much of the directional move in fitness philosophy has encompassed an aerobic approach. LaFontaine and Bruckerhoff (48) used highly intense aerobic circuit training in the rehabilitation of coronary artery disease patients who had undergone bypass surgery. They found improvement in heart rate with no abnormal responses related to cardiovascular or musculoskeletal complications.

The Wells Fargo Bank (83) has sponsored an aerobic circuit training course called "Gamefield." This type of course is sometimes referred to as a "fitness trail," and provides stations for selected flexibility and strength activities along a jogging
course. Separate courses, from Wells Fargo, are also operated in a walking and wheelchair format. This type of program has added to the popularity of circuit training and provided a program for participants in public parks and other available outdoor areas without the limitations of weight training apparatus or facilities.

In 1991, Cardinal (12) conducted a study on a subject population of nearly 11,000 subjects who followed a Nine Week Fast Fitness Circuit Training Program which alternated strength and aerobic activities for 27 minutes. Improvement was found in all fitness components evaluated.

It seems that there is little disagreement among the experts concerning the benefit of circuit training programs. Astrand (7) qualified his support for circuit training with the recommendation to screen out obese, elderly, sedentary, or medically restricted individuals from participation.

In summary, various research has shown that high intensity circuit training can produce significant benefits for participants who seek improvement in selected strength and aerobic fitness components.

Calisthenics

Calisthenics, or "light gymnastic exercises designed to develop grace as well as physical health and vigor" (6), have long been a part of physical exercise programs. Calisthenics, interspersed with total body movement activities, such as walking, jogging, rebounding, or running, have traditionally been viewed as less intense exercise programs when compared to circuit training. Combined with other
exercises, calisthenics have shown a positive improvement of selected fitness components (17, 18, 19, 75).

Harper (40) conducted a study to compare modified army conditioning drills consisting largely of calisthenics, forced marches and combatives with an interval training program of running. The calisthenics used were jumping jacks, push-ups, jumping, and squat thrusts with no information concerning work or rest periods given. The interval training group ran 110-, 220-, 440-, and 880-yard segments with a 5-minute complete rest between each run. The interval running group increased intensity and decreased the length of the rest periods as determined from a recovery heart rate taken by the participants themselves. Harper found that the calisthenics group improved significantly in the Harvard Step Test but failed to show any significant improvement in the max VO$_2$ test. The interval training group showed significant improvement in both max VO$_2$ and in the Harvard Step Test.

Cureton (18) found calisthenics a productive tool in the increase of aerobic capacity. In his study, middle aged sedentary men took part in an exercise program consisting of continuous rhythmic calisthenics interspersed with running, jogging, walking, and stretching with deep breathing. All parameters tested, including treadmill time and mile run time, showed significant improvement. It was not determined whether the gains resulted from the combination of activities involved in the exercise program or from just one of the individual components.

In an analogous study conducted by Cureton and Phillips (19), sedentary adult males participated in an exercise program incorporating 15 minutes of calisthenics, 30
to 40 minutes of running and 30 minutes of either handball or squash. Significant improvement was noted in 58% of the 70 cardiovascular and anthropometric measurements administered. These studies (18, 19) indicate that calisthenics coupled with a known cardiovascular enhancer, such as running or jogging, can be used to achieve a higher level of overall physical fitness.

Cureton (17) further showed that the continuous rhythmic endurance jogging with supplemental calisthenics was superior in the development of aerobic capacity when comparing to weight training (non-circuit) and game-related activities for adults. However, this study did not compare its jogging/calisthenics program with a "running only" program, nor did it evaluate performance results from calisthenics isolated from jogging.

As indicated by the previous studies, it seems that calisthenics benefits mostly on muscular strength gain while running, jogging, or walking provide improvement on cardiovascular fitness. In 1976, however, a program of timed-calisthenics utilizing calisthenics as a developer for both muscular strength and aerobic capacity was developed by Allsen (3). This program incorporated a series of eight exercises with 10 second rests between sets within each exercise. A circuit approach (of jogging for two minutes) was used between each of the eight exercises. In a follow-up study of this program, Dunn (26) found significant strength and aerobic improvement in 48 male and female college students.

The most recent amplification of calisthenics has been the addition of music to the calisthenics routine, which is known as aerobic dance. Although
commercialization has labeled this form of exercise everything from Jazzercise to Aerobicise, this type of continuous calisthenic training program has created a new wave of interest and increased participation in fitness centers around the world. Cooper (15) indicated that although quantifying the energy costs in this type of aerobic dance program is difficult, due to differences in practice intensities, aerobic gains could result if individual exercise heart rates are kept in target zones.

Traditionally, calisthenics have been used with other types of exercise. They have been an ingredient of a larger or overall circuit or system of activities used to improve cardiovascular endurance and other selected fitness components. With the development of aerobic dancing (3, 15), calisthenics have become the major ingredient in these programs. The arrangement of combining activities of calisthenics and jogging has made the exercise somewhat similar to the nature of interval training. That is, intensity of workload is altered between the so-called work and rest interval. In addition to modern calisthenic programs (aerobics) and circuit training previously reviewed, interval training is another format of the same alternating work and rest principle identified by Sorani (79).

Interval Training

Substantial research has been conducted in the area of interval training and the subsequent improvement in performance (11, 13, 14, 27, 28, 29, 30, 31, 37). Evans (27) found that a high-intensity interval type (successive repetition) cycling program significantly increased physical work capacity and anaerobic threshold without substantial changes in oxygen uptake parameters among the ten women tested.
In the instructional pamphlet on interval training, the President’s Council on Physical Fitness and Sports (69) concluded that an individual does not completely recover from an exercise before starting the next exercise interval. However, this recovery, though not complete, is sufficient to allow the participant to continue to perform subsequent higher intensity work. Saltin (73) examined at length the principal components of intermittent work when both the rest and work periods were considered in calculating work output and intensity. In determining the average work output, the amplitude or range was used to ascertain how much the exercise and rest periods vary from the average work output. This is essential when calculating the intensity of the work and the potential for recovery. Saltin found that if the duration of the intended exercise is less than 30 seconds, then the ratio between work and rest in the training program should be close to 1:1. Under this arrangement, only small variations in max VO₂ would be observed between work and rest period. It was also noted that the heart rate, which is related to oxygen uptake, experienced little fluctuation between work and rest when the exercise and rest periods are short.

Saltin further observed that a wide amplitude does not cause the respiratory quotient to become exceptionally high when the exercise and rest periods are short. His research indicated that continuous and intermittent exercise were found to produce similar aerobic results. Astrand (7) found that by spacing the work so that running periods lasted for 10 seconds, resting for 5 seconds, a subject could actually prolong the total work and rest period to 30 minutes without undue fatigue at a speed that normally exhausted him after about 4 minutes of continuous running. Gardner (33)
felt that interval running enables the runner to train longer at a faster speed than with continual running. He states that interval training should consist of repeated runs at sufficient speed to bring the heart rate up to 180 beats per minute or more with the rest periods allowing the heart rate to fall to approximately 120 beats per minute and then repeating the workout. Therefore, an exercise program of sufficient intensity with short work and rest periods could greatly out-produce in total workload a continuous program of equal intensity.

The contraction of skeletal muscle is powered by the breakdown of adenosine triphosphate (ATP). For muscular contraction to continue for more than a few seconds the level of ATP in the muscle must continually be restored. Replenishment of ATP can take place via the oxidative (aerobic) or glycolytic (anaerobic) pathways. While carbohydrate, fat, and protein can be metabolized with the oxidative pathways, only carbohydrate can be used for anaerobic metabolism. The by-product of anaerobic glycolysis is lactic acid. Since the exercise employed in the Timed-X physical fitness program of this study is high-intensity and very short-duration interval training in nature, the following review is limited to anaerobic energy metabolism.

As early as in 1933, Margaria et al. (49) used the term "alactacid oxygen debt" to describe the energy used during the initial phase of physical work. At the onset of exercise, the energy expenditure cannot be accounted for from anaerobic glycolysis in the sarcoplasm, nor aerobic oxidation of fat, protein, or carbohydrate in the mitochondrion. Energy supplied to the contractile elements of skeletal muscle is from chemical compounds collectively referred to as the phosphagens - ATP and
creatinephosphate (CP). However, only between 570 and 690 mM of phosphagens are normally stored in the total muscle mass of the body. This is equivalent to between 5.7 and 6.9 kcal of ATP energy, which does not represent very much energy for use during exercise, but is sufficient to supply energy for about 10 seconds of all-out work. The importance of this energy supply is obvious when performing fast and powerful movements because such activities demand a rapidly available supply rather than a large amount of energy.

One of the early studies on the effects of exercise on phosphagen depletion in human muscle came from Hultman and co-workers (45). They observed a linear relationship between work intensity and the reduction in muscular CP. ATP declined with moderate work and little further change was noted thereafter. Karlsson et al. (46) subsequently followed the ATP and CP levels in muscle over work intensities ranging from 60 to 100% of the aerobic power of trained and untrained subjects. They observed a small decline in ATP and a nearly linear decline in CP in both groups. Final CP concentration in the muscle was only about 25% that of the resting value. There was no difference in CP depletion pattern of the trained as compared to the untrained subjects. Knuttgen and Saltin (47) also studied the phosphagen concentrations in the muscles of man during 4 min bouts of exercise that required 19 to 95% of the subjects' maximal aerobic power. They reported that CP was approximately depleted after working at 75% of aerobic power, with only a slight additional decline occurring at the highest work load. These studies demonstrated that
the major role of CP is to reload the ATP for muscular contraction during the so-called "alactacid oxygen debt" phase of an anaerobic event.

Phosphagens depleted in muscle during exercise are restored very rapidly, within a few minutes following exercise (41, 45). Hultman et al. (45) reported that the phosphagen restoration is very rapid at first, then somewhat slower, being 70% completed within 30 seconds and 100% completed within 3 to 5 minutes during recovery. In addition, the restoration of CP will not take place in muscle when the blood flow is occluded (41), which indicates that the energy required for phosphagen restoration is provided mainly by the aerobic breakdown of carbohydrate and fats to \( \text{CO}_2 \) and \( \text{H}_2\text{O} \) via the TCA (Krebs) Cycle and the electron transport system. The greater the phosphagen depletion during exercise, the greater the amount of oxygen required during recovery for restoration. A larger amount of oxygen is consumed during the rapid recovery phase since about 70% of phosphagen restoration is completed within 30 seconds. It was reported that the rapid recovery of oxygen consumption ranges between 2.0 and 3.0 liters in untrained athletes. For example, levels of over 6.0 liters have been recorded in male competitive rowers which can be interpreted to mean that a large amount of phosphagen is restored during recovery (39). This has important applications in physical performance because the amount of phosphagen available (capacity) and its rate of utilization (power) are directly related to an individual’s ability to generate and sustain power movements or activities.

The other anaerobic system in the muscle for ATP resynthesis is anaerobic glycolysis, in which carbohydrate, in the form of glucose, can be incompletely broken
down as lactic acid in the sarcoplasm. During this more complicated chemical process, a small portion of potential energy in the glucose is released to resynthesize ATP. Anaerobic glycolysis, like the phosphagen, is extremely important during exercise primarily because it also provides a relatively rapid supply of ATP. This does not mean to imply that anaerobic metabolism is the only system operating. It merely indicates that the ATP required for these types of exercise cannot be supplied via the aerobic system alone. There are two reasons why there is a limitation of the aerobic system in supplying adequate ATP under these conditions: 1) individual’s have a ceiling for their maximum rate at which they can consume oxygen and use the aerobic energy metabolism for ATP production (aerobic power); and 2) it takes at least 2 or 3 minutes for oxygen consumption to increase to a new, higher level. For example, trained athletes have a maximal aerobic power of between 3.0 and 5.0 liters of oxygen per minute for female and males, respectively (24, 74), whereas the maximum for the untrained female is around 2.2 liters per minute and the untrained male, 3.2 liters per minute (25, 27). These levels of oxygen consumption are not nearly enough in either case to supply all the ATP needed for such an effort as the 100 meter dash, which may require in excess of 45 liters per minute (about 8 liters of oxygen per 100 meters or per 10 seconds). Even if it were possible for the aerobic metabolic system to produce ATP at this rate, it would take the first 2 or 3 minutes of exercise to accelerate the oxygen consumption to the required level. The period, during which the level of oxygen consumption is below that necessary to supply all the ATP required of any exercise, is called the oxygen deficit period. It is during this
oxygen deficit period that the phosphagen system and anaerobic glycolysis are called upon to supply most of the ATP required for the exercise.

It is important to recognize that adaptation of a specific exercise regimen not only occurs during exercise, it also takes place in the recovery period. During this time, many physiological and biochemical processes take place in an attempt to restore the body to its pre-exercise condition, including replenishing the energy stores that were depleted and removing any lactic acid that accumulated during exercise. Extra oxygen is consumed during recovery. However, the rate at which oxygen is consumed is not constant throughout the recovery period. During the first 2 or 3 minutes of recovery, oxygen consumption declines very rapidly, then more slowly until a constant rate, equivalent to resting levels, is reached. The initial rapid portion of recovery is known as the fast component, whereas the slower phase is referred to as the slow component (42, 49). The elevated oxygen consumption during the fast component of recovery would include resaturation of myoglobin with oxygen, restoration of blood levels of oxygen, the energy cost of elevated ventilation and heart activity, and probably most significantly, the replenishment of phosphagens (42). The elevated oxygen consumption during the slow component of recovery is known to be associated with a number of physiological events including elevated body temperature, the oxygen cost of ventilation, the oxygen cost of increased myocardial activity, increases in sodium and potassium pump activities, glycogen resynthesis, the calorigenic effect of catecholamines, and oxidation of lactic acid, among other factors (4, 8, 9, 32, 38).
It is well documented that the ATP energy required for phosphagen restoration is provided mainly by the aerobic system through the oxygen consumed during the fast component of the recovery period (21, 66, 67). The fact that oxygen is required for this process is clearly shown by the requirement of circulation and thus the oxygen supply to muscle during recovery (41). Because most of the energy for phosphagen restoration arises from the fast component of recovery, the fast component declines very rapidly and completes in 3 to 6 minutes. It is estimated that the half reaction time of replenishment is 30 seconds or less (38). This means that in 30 seconds, one-half of the total fast component of recovery is completed. In fact, the actual rate at which the ATP and CP stores are replenished is somewhat greater, with 70% rather than 50% restored in 30 seconds. The reason for this discrepancy is that the amount of oxygen consumed during recovery includes, as mentioned previously, not only enough oxygen to replace the depleted phosphagen but also to provide a certain amount of extra oxygen needed to replace the depleted oxygen stores (about 0.6 liter oxygen in maximal exercise). This also includes about 50 ml of extra oxygen required of the still-activated heart and respiratory muscles, a certain amount of extra oxygen required by the body in general due to increased tissue temperature and catecholamine effects. With these corrections, the half-reaction time is around 20 seconds, which is in close agreement with the actual phosphagen restoration rate as determined from muscle sample analysis (21, 49). The maximum size of the fast component ranges between 2 and 3 liters of oxygen in untrained males (67); higher values are associated with well-trained athletes. For example, levels of over 6 liters
have been recorded in male competitive rowers (39). Such a large fast component for recovery can be interpreted to mean that a large amount of phosphagens were depleted during exercise and would need to be restored during recovery. This also means that if one can develop, through training, a greater capacity of the fast component of oxygen recovery, large quantities of phosphagen would be available for use during exercise. Since the energy for phosphagen replenishment comes from the breakdown of carbohydrate and fats, and perhaps a small amount of lactic acid, to CO₂ and H₂O via the Krebs Cycle and the electron transport system, the rate of aerobic energy production is extremely high under this circumstance. Consequently, exercise in this nature will also develop one’s aerobic capacity up to a certain extent.

Summary of Physical Fitness Programs

Circuit training, modern calisthenics, and interval training have been shown to improve the cardiovascular system if the intensity of the exercise bout is sufficient. Greater workloads can be endured for longer periods of time if there is a rest between each exercise period. Both the length of the rest and the exercise period are critical in allowing the physiological responses of the body to maintain an equilibrium. This maintenance of the energy balance allows the exercise regimen to continue for several minutes duration without undue fatigue. Improvement in health-related physical fitness is based on sufficient exercise intensity.

Selected Current Physical Education Curricula

A thorough literature search surprisingly reveals that there are no health-related physical fitness programs endorsed on a national level for high school use.
The high school physical education curriculum in the vast majority of public high schools in the United States are based upon the recommendations of national physical education organizations.

The State of Hawaii uses as a guideline for its physical education programs the "Definition of the Physically Educated Person: Outcomes of Quality Physical Education Programs" (56). This document (see appendix A), approved by the National Association of Sport and Physical Education (NASPE), outlines 20 behavioral outcomes which are to be met by all of the physical education programs throughout the state. Of the 20 behavioral outcomes identified in this guide for high school physical education programs, only two are directly related to physical fitness. They are No. 7, "...assesses, achieves and maintains physical fitness," and No. 9, "...participates in health enhancing physical activity at least three times a week."

Selected high school physical education classes in the State of Hawaii meet for 45 minutes each of three days per week. Included in the 135 minutes per week is approximately 30 minutes (or 10 minutes per class period) for locker room time (57). The Department of Education (DOE) has adopted an "Essential Content" document which outlines standards in each academic discipline. Individual schools or districts pattern their curriculum to meet the standards outlined as essential content (20). The DOE's essential content for physical education is separated into four categories: 1) physical development, 2) psychomotor development, 3) cognitive development, and 4) sportsmanship. The essential content in each of the categories is separated according to four grade divisions: They are grades K-3, grades 4-6, grades 7-8, and grades 9-
12. This study is concerned with a model high school physical fitness program and therefore will review only the physical development essential content for high school grades 9-12.

"Physical fitness is the degree to which the body can meet the physical demands of daily living. This includes the development and maintenance of cardiovascular endurance, muscular strength and endurance, agility, flexibility to execute and control body movement, and a desirable weight and body composition."

Physical development should include:

- Utilization of muscular strength and endurance, flexibility and agility while participating in games, sports, dance, outdoor pursuits, and other physical activities for the maintenance of wellness.

- Maturation of muscular, skeletal, and cardiovascular systems.

With the exception of agility, a motor fitness component, each of the criteria listed in the essential content's description of physical fitness can be directed to the health-related fitness ideal. Based on AAHPERD's PHYSICAL BEST youth fitness test, the recommendation of NASPE, and the DOE's "Essential Content" document, it is recommended by this writer that high school physical fitness programs specifically include the development and maintenance of cardiovascular endurance, muscular strength and endurance, flexibility, and body composition. Adopting a health-related physical fitness program in Hawaii high schools would not be a difficult task.

In high school's across the country the number and type of facilities and their quality vary. Some schools have excellent outdoor tracks, large grass fields, and beautiful hardwood floors in their gymnasiums. Others are not so fortunate. In many geographical regions of the United States a year-round outdoor physical education experience is commonplace. However, even in locations with somewhat "ideal"
climates such as Hawaii, Southern California, and Florida, there are weather conditions which prevent continuous outdoor activity. Other geographical regions, such as New England, the Midwest, and the Rockies, spend a significant portion of the school year in weather conditions unsuitable for outdoor physical education curriculum. Very few public schools have indoor tracks, or cardiovascular enhancing devices such as stairmasters, rowing machines, or ergometers. Geographical location along with facility and equipment limitations play a significant role in the opportunity for the consistent attainment of health-related fitness goals.

In conclusion, research has clearly indicated that high-intensity interval type training (alternating work and rest periods) can produce the health-related fitness goals of a high school physical education program. The philosophy behind the development of a model program (Timed-X physical fitness) is to provide a vehicle for achieving health-related fitness with an equal and fair approach to the physical education classroom setting. The research cited in this chapter indicates that health-related physical fitness can be achieved with this type of program.
CHAPTER III

PROCEDURES

This chapter will present the procedures used in The Development, Field Testing, and Implementation of a Model High School Physical Fitness Program.

Development

I originally designed the Timed-X physical fitness program to provide an equal and fair approach to health-related physical fitness on the high school level. My own experience had been one of equal but unfair expectations and requirements. I attended three different high schools during my ninth through twelfth grades. In ninth grade I was living in England and attended an all boys school which was traditional in every sense of the word. We wore gray slacks, blue blazers, a red striped tie with the school emblem on it, and a white shirt. I was actually sent to see the headmaster one day for wearing a blue shirt. During grades 10 and 11 I was back in the U.S.A. and attended a prestigious private high school with a very limited enrollment (30 students maximum per grade level). My senior year in high school I attended the public school in town since the private school had closed at the end of my junior year. My graduating class was five times as large as the entire school I had attended the previous two years. The physical education portion of these varied high school experiences had one common element. All students were treated equally. Each physical education teacher, or curriculum, or philosophy, or program, was based on each student completing or reaching a predetermined standard. Whether the standard was high, low, or just right for most students is not the point. The point is that each
student was expected to achieve a certain standard or performance level. For some, the standard was impossible (at that point in time), for some, it was just a warm-up, and for probably the majority of the students it was challenging.

I believed then and believe now that to be equal one must also be fair. It was not fair to expect the "fat kid" to run as far, do as many push-ups, or climb as high on the rope as those of us who lived for sports and athletics and were already excelling at them. Robert Singer once said that, "learners come to the learning situation with dissimilar probability for success." If that is true, and my experience tells me that it is, then physical educators (all educators for that matter) must find ways to challenge learners on every level. It is for this reason that I saw a need for an equal and fair physical fitness program. One that would give self-esteem to everyone. One that, like life, expects more from those who have more.

The Timed-X program is what I came up with. It has been recorded on an audio cassette to ensure consistency and accuracy. In this program, an individual’s own body weight is used as the resistance against which his/her cardiovascular, circulo-respiratory and muscular systems are exercised. Prior to a warm-up session (suggested activities in appendix B Diagrams, appendix C Pictures), the participant makes note of his/her resting heart rate. Following this, the participant alternates between ten-second exercise periods and ten-second rest periods. During the exercise period, an individual exercises as intensely as possible according to his/her abilities and level of fitness for three sets before selecting and starting another exercise. With only a ten-second rest period between the changes of exercises, the entire exercise...
portion of the program should last for a recommended 15 minutes and include 15 different exercises. The cool down period consists of a few minutes of flexibility exercises (suggested activities in appendix B Diagrams, appendix C Pictures) and slow jumping jacks. What is equal in the Timed-X program are the 10-second intervals of exercise and the 10-second intervals of rest. The program lasts for 15 minutes whether you look like Arnold Schwarzenegger or Konishiki. What is fair in the Timed-X program is that every participant exercises at full intensity. One participant may do 10 push-ups in each push-up interval while another may only do four. If both participants work at their highest exercise level they are each able to achieve their "best" workout. For an instructor, there is no guess work in determining whether a participant gave their best effort. It is simply a matter of taking their exercise heart rate. It is much easier to fake a hard workout than it is to fake an exercise heart rate. Participants soon became aware of it. The exercise heart rate becomes the standard of fairness that lets real equality take place in the physical fitness arena. Each participant is to work at a level that will keep their exercise heart rate in the target or training zone.

The advantages of the Timed-X physical fitness program for high school students are as follows:

1. Participants follow a pre-recorded audio tape.
2. Participants need no special equipment.
3. The exercises involve easy-to-learn motor patterns.
4. A large variety of exercises allow participants to modify or amplify the program as conditioning levels and/or individual needs arise.

5. Specific muscle groups of the body can be isolated and developed.

6. Results can be easily felt and observed by participants.

7. Any number of participants may exercise at one time according to space availability.

8. The exercises do not require a lot of space.

9. The level of cardiovascular fitness and muscular strength can be increased.

10. Participants with varying levels of physical fitness can all exercise at the same time and still experience a personally challenging workout.

In addition to enhancing the aerobic capacity of the participant, the Timed-X physical fitness program consists of exercises that target three of the body’s major muscle groups; specifically, the muscles of the upper, middle and lower body. Each of the exercises is explained in detail in later paragraphs.

1. Upper body exercises include: push-ups with the elbows in, push-ups with the elbows out, push-ups with the hands forming a triangle at forehead height, handstand push-ups against a wall, and pull-ups (if a bar is available). (diagrams in appendix D and photos in appendix G)

2. Abdominal exercises include: curl-ups, double-ups, V-ups, up and outs, spread eagle, raised calves or calves across chair, and roman chairs. (diagrams in appendix E and photos in appendix H)
3. Lower body exercises include: squat thrusts, running in place, jumping jacks, jumping, kangaroo hops, mountain climber, treadmill I, treadmill II, sidewinder I, sidewinder II, hip swivel, crab kick, and russian toe jumps. (diagrams in appendix F and photos in appendix I)

The exercises and the suggested order for doing them are included on a cassette tape, side A, and listed as follows:

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Sets</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Squat thrusts</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>2. V-ups</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>3. Push-ups elbows in</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>4. Hip swivel</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>5. Sidewinder II (left)</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>6. Running in place</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>7. Double-ups</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>8. Triangle push-ups</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>9. Treadmill II</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>10. Sidewinder II (right)</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>11. Kangaroo hops</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>12. Curl-ups</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>13. Push-ups elbows out</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>14. Treadmill I</td>
<td>3</td>
<td>1 minute</td>
</tr>
<tr>
<td>15. Choice of 1, 6, or 11 (i.e. squat thrusts, running in place, or kangaroo hops)</td>
<td>3</td>
<td>15 minutes</td>
</tr>
</tbody>
</table>

The audio cassette tape includes the taking of a resting heart rate, warm-up, stretching, the fifteen minute Timed-X program (listed above), the taking of an exercise heart rate, a cool-down period including stretching, and the taking of a recovery heart rate. Side B of the audio cassette tape contains the same program as found on side A without a pre-determined exercise order. During the exercise portion of side B only "go" and "rest" along with appropriate motivation is given. Each
participant is free to select any of the exercises and the order of those exercises. On side A the exercises are rotated among the major muscle groups of lower, middle and upper body, respectively. The rationale for this rotation is to enable the participant to avoid local muscular fatigue and to maintain maximal effort throughout the entire exercise period.

An explanation of the exercises according to the major muscle groups is as follows:

**Upper Body Exercises:** (see diagrams in appendix D and photos in appendix G)

**Push-ups with the elbows in.** Assume a standard push-up position—hands are positioned shoulder width apart, arms extended, and legs completely behind the body. Lower the body until the chest touches the ground with the elbows directly back toward the feet. Extend back up to the initial push-up position.

**Push-ups with the elbows out.** Assume standard push-up position. Drop or lower body, until chest touches the ground with elbows pointing out away from the midline of the body. Extend arms back up to initial push-up position.

**Push-ups with hands forming a triangle.** The hands should be placed forming a triangle far enough in front of the body that when the body is lowered, the forehead will land in the triangle. As the body is lowered and the forehead is placed in the triangle, the abdomen should also gently touch the ground. Extend arms, putting body back up to initial push-up position.

**Handstand push-ups against a wall.** Stand on your hands with feet balancing against wall. Lower the body until the nose touches against the ground and extend body back to beginning position.

**Pull-ups.** Hanging from a bar or doorway, with palms facing away from the body, pull up until the chin is extended above that area which is being held onto by the hands.

**Mid-Body Exercises:** (see diagrams in appendix E and photos in appendix H)
**Curl-ups.** Lying on your back with your knees bent and feet flat on the ground, placing your wrists across the chest, bring your back gradually up off the ground until you are sitting up. Then lower yourself to beginning position and begin again.

**Double-ups.** Lying on your back with your arms across your stomach, lift your feet six inches off the ground. Your knees should be locked. Bring your chest and shoulders up to a sitting position while at the same time bending the knees so that the knees and the chest meet in the middle. Extend back out to original position keeping the feet from touching the ground and begin again.

**V-ups.** While lying on the back with the arms and legs completely extended, raise them off the ground six inches. Bring the arms and the legs, while maintaining an extended position, up toward each other until the finger tips touch the toes. Extend back out until you have reached the beginning position with the arms and feet off the ground, and begin again.

**Up and out.** With the arms out directly from the body and the palms down, lift the legs off the ground until they are directly pointed toward the ceiling. Bend the knees down and extend the legs out in front, until the knees are locked. Repeat.

**Spread Eagle.** Lie on the back with the arms and legs spread as wide as possible. Raise them up off the ground six inches and hold throughout the 10 second period of time.

**Calves in air or calves across chair.** While lying on the back with your legs bent at the knee and your lower leg parallel to the ground, as if the lower leg were resting on a bench or chair, place your wrists across the chest and curl up. Repeat.

**Roman chairs.** While sitting on a bench or chair, hook your feet under an object or pointing your toes into the ground for support, lean backwards until the shoulders are level with the hips. Rotate the trunk of the body until the shoulders are perpendicular to the floor. Rotate back until the shoulders are level with the hips. Come forward to the beginning position. Extend backwards until the shoulders are level with the hips. Rotate the shoulders the opposite direction, back to the shoulders level with the hips, and up to beginning position. Repeat.

**Lower Body Exercises:** (see diagrams in appendix F and photos in appendix I)

**Running in place.** While somewhat self explanatory this exercise should accentuate the knees achieving a height equal to or above the waist. It should be done as fast as possible, reaching at least 18 counts, one count being each time the right foot hits the ground.
Squat thrusts. From a standing position, squat down to all fours with knees bent. Extend feet completely behind so that you are in beginning push-up position. Bring feet back to squatting position. Stand up to beginning position with hands on hips. Repeat.

Jumping Jacks. Standing with the hands down to the sides, jump in the air, spreading the feet and bringing the arms to the outside of your body until your hands touch and the feet are on the ground spread about shoulder width apart. Return to initial position.

Jumping. Crouch in a jumping position. Jump as high as possible in the air, reaching up with both hands. As soon as you land, repeat.

Kangaroo Hops. Start again in jumping position. Jump as high as possible and bring the knees to the chest until they touch. Jump again as soon as your feet touch the ground.

Mountain climber. Start in a kneeling position. Bring your right leg up off the ground so that your left knee is no longer touching the ground. Bring both feet up until you are in a squatting position with heels off the ground. Lower opposite leg without letting the knee touch. Return to the beginning and repeat.

Treadmill I. Starting in a push-up position, bring your left leg forward until your foot is underneath your waist. There should be at least a two to three foot distance between your feet. Change positions so that now your right foot is in front and your left leg is behind. Do as many as possible in the 10 second period of time.

Treadmill II. This exercise is almost the same as Treadmill I with the exception that instead of the foot coming up underneath the chest, the foot comes up to the outside of the hand on the same side of the body.

Sidewinder I. Lie on your side with your legs extended. Place your right arm in front for balance. Lift your leg as high to the side as you can, maintaining a direct line from shoulder to foot.

Sidewinder II. This exercise is the same as Sidewinder I with the exception that your body weight is being supported by your extended arm.

Hip swivel. Starting in a push-up position, bring your left leg underneath your right leg until it is almost up level with your hand. Switch, by rotating your hips so that now your right leg is underneath your left leg.

Crab kick. While in a seated position with the hands placed palm down behind you and the weight of your body on your hands and feet, alternate touching
right hand with left foot and left hand with right foot. The only body parts allowed to
touch the ground are the hands and the feet.

- **Russian toe jumps.** From a standard pre-jumping position jump in the air as
  high as possible while bringing both legs, with knees locked, as wide as possible.
The hands should touch the toes simulating a position used is the stretching warm-up.

Ten seconds following the completion of the third set of the final exercise, at
the moment that a new exercise would normally begin, an exercise heart rate is
measured. Three minutes later, following slow walking and easy stretching, a
recovery heart rate is measured. Heart rates are measured by placing the index and
middle finger of the right hand on the right side of the throat and gently pressing
against the carotid artery. Pulse beats should be counted for 20 seconds with the
number counted multiplied by three. This number is used to represent the exercise
heart rate and recovery heart rate. The rate at which the heart recovers from exercise
is one means of determining the strength of the heart. The purpose for taking a
recovery heart rate three minutes following the taking of an exercise heart rate is to
identify those participants who may be working at an exercise intensity unsafe for
their current fitness level. If a participants heart has not recovered to a rate below
120 beats per minute three minutes following exercise, they are counseled to exercise
with less intensity. This safeguard is a precaution against inappropriate exercise
intensity and provides less conditioned participants with an acceptable defense against
peer pressure.

The exercises used in the Timed-X program along with the warm-up, cool-
down, and stretching activities were selected from my own experience and the
suggestions of friends familiar with my intent. I compiled a list of exercises and
measured them against two objectives. The first was whether the exercise would be able to maintain the exercise heart rate of a relatively fit student. The second objective was to find a balance between general areas, i.e. upper, mid-, and lower body groups. Although some of the exercises listed may seem unlikely choices, they provide a variety of activity, neuromotor coordination, and muscular development. It is not intended that these exercises be thought of as the only exercises that will work within the philosophy of this program. I am certain that there are numerous exercises and activities that could be drawn from to produce similar results. The principles of the Timed-X program work. The exercises I selected are simply some of those that can be used to achieve an equal and fair physical fitness program.

Field Testing

The Timed-X physical fitness program needed to be field tested against some standard that would be acceptable to physical education teachers and fitness experts nationwide. Experts have unanimously acknowledged the work of Dr. Kenneth Cooper and many have recognized his work by using his fitness tables as standards and indicators on which students and clients have been evaluated. I became familiar with and used his tables when teaching Fitness for Life (3) courses. The Fitness for Life program uses a 1.5 mile run and a body composition evaluation as a means for determining fitness. I was comfortable with these tests and believed them to be valid and accurate indicators of fitness. Since it is widely accepted that jogging can produce cardiovascular strength gains and that a decrease in body fat also accompanies this type of activity I decided to place jogging opposite the Timed-X
program for an equal period of time. To validate both test groups, a control group was needed, and I felt that some activity was appropriate but not any that might produce cardiovascular strength gains. The control group was allowed to choose between volleyball, half-court basketball, weight lifting, or table tennis.

I wanted to find an environment where the two test groups and the control group could be regulated as much as possible. The Missionary Training Center of The Church of Jesus Christ of Latter-Day Saints has as many as 2,000 nineteen year-old men in one campus area at a time. They have such a rigorous educational program of language and culture that I knew (from having worked there) the outside exercise would be very limited if at all. Meals are provided at the MTC in a cafeteria setting and therefore diet was also somewhat controlled. I struggled with the age being slightly post-high school but felt that the advantages of the controlled facility outweighed the additional 12-24 months since graduation.

The following procedures were utilized in the field testing of the Timed-X physical fitness program.

Subjects

Sixty young men, nineteen years of age, who had entered the Missionary Training Center (MTC) in preparation for a two-year religious proselyting mission to Japan were selected as subjects for this study.

All participants were required to take part in a physical education program. This physical education class was held 5 days a week and was required of all MTC
residents. The participants of this study were all aware that they were a part of a research project.

**Determining Experimental and Control Groups**

Subjects were organized into two experimental and one control group in the following manner. Each subject was assigned a number from one to sixty. Sixty numbered chips were placed into a hat and drawn one at a time. The first twenty numbered chips identified subjects for the Timed-X experimental group. The second twenty numbered chips identified subjects for the jogging experimental group. The remaining twenty numbered chips identified subjects for the control group. Each subject was notified of the research group to which he was assigned.

**Testing Procedures**

All of the subjects in each group participated in the following pre- and post-tests.

1.5 Mile Run

Kenneth Cooper (12) established the 1.5 mile run as a fitness level indicator. Because no regulation track was available, a temporary running course was set up near the indoor physical education facility at the MTC. Since the one lap distance was approximately 126 yards, each subject had to run twenty-one laps in order to cover 1.5 miles. Times were kept on a Robic SC 500 Chronometer and recorded to the nearest full second.
Body Composition

Body composition was determined by skinfold measurements obtained by a Harpenden Skinfold Caliper. All measurements were taken on the right side of the body. Subjects were instructed to contract the muscle beneath the area to be skinfolded and then to relax it. The thumb and index finger pinched the skin at three selected sites while the subjects stood in the anatomical position. The pinched skin included a layer of subcutaneous fat and two skin thicknesses. The calipers were applied approximately one centimeter from the thumb and index finger pinching the skinfold. The process was repeated three times for each measurement with the mean of the three measurements used as the final score at each site. As the program developer and tester I conducted all skinfold testing. An assistant recorded each measurement after verbally repeating the skinfold number I identified to them.

The three selected sites used were: chest, abdomen, and thigh. These sites were chosen, again from familiarity, from the fitness for life program.

Chest: taken over the outside edge of the pectoralis major muscle, just medial to the armpit. The skinfold will run diagonally between the shoulder and the opposite hip.

Abdomen: taken as a vertical fold approximately 2.45 cm from the center of the umbilicus.

Thigh: taken as a vertical fold in the anterior midline of the thigh, midway between the hip and knee joints. Weight will be placed on the opposite leg producing a relaxed state in the thigh muscle.
The sum of the three skinfolds, in millimeters, were used in the statistical analysis.

**Equipment**

The following equipment was used in this study:

**Harpenden Skinfold Caliper:**

The Harpenden skinfold caliper is designed to exert a constant pressure of 0.01 Kg/mm$^2$ (0.098 N/mm$^2$) $\pm$ 10% at all openings of the 90mm$^2$ anvils. The caliper used in this study was tested and the total pressure exerted found to be 890 gms.

**Robic SC 500 Sports Chronometer.**

**Statistical Model**

Differences between the pre- and post-tests of the three groups were determined with an analysis of variance. The .05 level of confidence was used to determine significance.

**Implementation**

The following is background information and the procedures followed in the implementation of the Timed-X model high school physical fitness program.

The Timed-X physical fitness program was implemented in the physical education department of the Moroni High School in the Village of Eita on the Island of Tarawa, in Kiribati. I selected this school largely because the physical education department head was a former student and was looking for ways to improve his developing curriculum.
A Brief History

Kiribati (formerly the Gilbert Islands) is an independent nation of approximately sixty thousand people. It is located in the Central Pacific. The thirty-three islands, or coral atolls, have a total land area of about 260 square miles and are spread across approximately two million square miles of ocean. (85)

The climate in Kiribati is at the mercy of the Pacific Ocean. Tarawa, the governmental center of the country, is located where the International Date Line crosses the Equator. Both temperature and rainfall vary little during the year. August and September are the driest months with December and January bringing the most precipitation. Droughts are a serious problem on all the islands particularly in the Southern Gilbert chain. The occasional winds which bring a squall or heavy rainstorm are looked to as almost a religious manifestation. (80)

The citizens of Kiribati, called I-Kiribati (pronounced ee-kiribas) are of Micronesian and Polynesian ancestry. They speak one language which is common to all islands. Although it is not known when they first became inhabited it is commonly believed to have been around 300 AD. (85)

The Europeans discovery of the Gilbert Islands began in the late 1500’s and expanded as the sperm whale industry expanded. Some whalers deserted their ships and settled in the Gilberts. As time passed these men became respected residents and often became traders or agents for firms in Australia, America, and Germany.

Not long after the first traders came Christianity was introduced by Dr. Hiram Bingham of the American Board of Foreign Missions. Dr. Bingham was assisted by
a number of Hawaiian Pastors. Following the arrival of the Protestant Church the Catholic Church established a mission including schools in the Gilberts. The Churches used their schools as a means of preaching their message. Village schools were set up on many islands. Today many Christian faiths have established missions in the Gilberts.

In 1892 the Gilbert Islands became a British Protectorate and in 1916 a Crown Colony. Although occupied by the Japanese during most of World War II and liberated by the American Marines during the intense Battle of Tarawa, it was not until 1979 that the Gilbert Islands formally ended ties with Great Britain. On July 12, 1979, Kiribati emerged as an independent nation seeking to establish itself with autonomy from both Western and Eastern Bloc nations. It maintained a close relationship with Australia, the United States, and Japan, and became the first Pacific nation to sell unrestricted fishing rights to the then Soviet Union. (85)

The Growth of Education

Outside of subsidizing the primary schools established in the villages by the Churches, the colonial government did nothing to educate the Gilbertese until 1922. It was then that King George V school was set up to educate the locals for minor clerical administrative positions. In 1953, King George V Secondary School was built, in its current location, in Bikenibeu, on Tarawa. In 1959, the Elaine Bernacchi Secondary School for girls was built on adjoining property with various facilities being shared. (80)
The Tarawa Teachers College was established in the late 1950's and expanded
to a maximum of 60 students in the mid-1960's. It was also built in Bikenibeu where
the headquarters for the Ministry of Education were housed. In 1977 the Ministry of
Education, still under the direction of the Crown Colony, took control over all
primary education. It ran a six-year program with qualified teachers from among the
graduates of the Tarawa Teachers College.

Soon the demand for secondary education far exceeded the capacity of King
George V and Elaine Bernacchi Schools. Again the government, with the approval of
the Ministry of Education, allowed Churches to become directly involved with
education. Accreditation was given to qualifying schools who followed the
"Prescription," the national curriculum required by the Ministry of Education for
Forms I-Form V and Form VI where applicable. A sixth form was added at some of
the schools to allow graduating students an opportunity to meet requirements for
higher education overseas. Only the government school, KGV/BBS are presently
allowed to teach a form 7.

Today there are eight secondary schools on Tarawa. Seven of these are
owned, operated, and maintained by Churches. The Church of Jesus Christ of Latter­
Day Saints (Moroni High School); The Seventh Day Adventist Church (Seventh Day
Adventist High School); The Protestant Church (SWHS and Hiram Bingham High
School); and The Catholic Church (Catholic Senior College, Catholic Junior College,
and St. Louis High School). Seven of these academic secondary schools are boarding
facilities and all are co-educational. (55)
Over 6,000 qualifying primary school graduates sit an entrance examination for only 600 places in these eight schools each year. Although the 600 incoming students are already in an elite class, the cream of this group (approximately 20%) attends the government schools in Bikenibeu, where all educational costs are paid for by the Ministry of Education. The students at King George V and Elaine Bernacchi Schools have the finest facilities, the most respected and experienced teachers with respect to degrees earned and time in tenure, and an assurance of government employment upon successful graduation.

The Moroni Community School

Established in 1977 by the Church of Jesus Christ of Latter-Day Saints, the Moroni Community School has grown in facilities, size, and respectability. The physical education facilities consist of a dirt soccer field and a single cement tennis court. The interior of the soccer field and the area in the general vicinity surrounding it are also used for track and field events, i.e. sprints, long jump, shot put, discus, high jump, and hurdles, etc. Volleyball is played on the tennis court and basketball is played on a half-court single standard dirt court near the soccer field. The wood floor "cultural hall," a part of the religious chapel building, is used for lecture or rainy day activities.

Implementation Process of the Timed-X Physical Fitness Program

After an evaluation of the "Prescription," it was found that no specific curriculum was required for physical education. Guidelines concerning general health improvement through participation, along with an introduction to sports of the South
Pacific, were recommended. A committee was established at my request to determine the goals and desired outcomes of the school's physical education program. The committee consisted of the school principal, the physical education department chairman, all physical education faculty and staff, and myself. Goals and outcomes included general fitness of the students, good sportsmanship, and athletic success.

The committee defined athletic success as the position of finish in interschool competition in athletics (track & field), soccer, and basketball. Discussion included how the Timed-X program would assist in reaching those goals and desired outcomes. The committee determined that the Timed-X program would assist in fulfilling the goals and desired outcomes of the Moroni High School. The committee also concluded that the Timed-X program would meet the general health-related recommendation and allow time for the sports introduction recommended by the Ministry of Education. The Timed-X physical fitness program was implemented under the direction of the committee with the chairman of the physical education department and myself responsible for overseeing the implementation. Under criteria established by the Ministry of Education, physical education is required for Forms I-III and is an acceptable elective in Forms IV-V. For the purposes of implementation the committee determined to use the Timed-X program in Forms I-III only.

The committee determined that an effective implementation process would include, but would not be limited to, the following methods. First, I would demonstrate the Timed-X program. It was felt that this would provide students and committee members with a visual experience of the program. Second, I would
personally instruct each committee member in the correct motor pattern of all of the exercises. Third, the committee members would, under my direction, instruct and monitor each other in the motor patterns used for all exercises. Fourth, provide a practice session for each instructor to perform the complete program for students. This would also take place under my supervision. Fifth, allow the students time and instruction in learning the correct motor pattern of each exercise. This would be done with more than one instructor present and under my supervision. (This would be the beginning of actual class instruction). Sixth, an opportunity for physical education faculty to teach a class using the Timed-X program without any other instructor assistance. This teaching opportunity would allow for both demonstrator and supervisor roles. Seventh, feedback from students, program instructors, and administrators (via other school faculty) concerning challenges arising from the Timed-X program.

The committee decided to divided each Form into two sections. These sections were designated by gender. With all students participating in physical education in their school uniforms, and the girls’ uniforms being skirts and blouses, the committee felt that separating the boys from the girls during this program would promote modesty. It was determined that section one, in each form, would be the girls and section two, in each form, would be the boys. The class size varied between 81 students in Form III to 21 students in Form VI. Form I had 76 students, Form II 79, and Form III 81. Forms IV-VI had 66, 60, and 21 respectively.
Whether required (Forms I-III) or elective (Forms IV-VI), each form is assigned physical education three times each week.

Class periods were 45 minutes long. The committee decided to have both sections of each form meet together for roll call, warm-up and stretch.

The Timed-X program takes approximately 25 minutes, including warm-up and cool-down. Under the implementation schedule approved by the committee, the Timed-X warm-up would be utilized by both sections while a silent roll was being taken. The girls section would stay and continue with the 15 minute exercise portion of the Timed-X program while the boys section would go to the outdoor physical education area for sport-specific skill development. At the time of the implementation the sport-specific skill being taught were those of athletics or track and field.

Immediately following the completion of the exercise portion of the Timed-X cassette tape version there is a three minute cool-down. It was further determined by the Committee that the girls section would complete the cool-down and have two minutes to report to the outdoor skill development area. The boys section would leave the skill development area after 15 minutes, the length of the exercise portion of the program, and move into position to replace the girls section. The boys section would arrive in the Timed-X area while the girls section was still cooling-down. The boys section would be ready to replace the girls section as soon as they left. The time between the completion of the Timed-X exercise program for the girls section and the beginning of the Timed-X exercise program for the boys section was five minutes. The first three minutes were used in a cool-down for the girls section. This left the
instructor with two minutes to dry the floor of perspiration, position the boys section, and begin the second cassette tape. It was determined by the committee that a dual cassette player would be used in order to allow an instructor to pre-set two tapes and thus avoid the necessity of rewinding, between sections. This five-minute interim would allow time for both sections to be in place as the boys section began the Timed-X cassette tape exercise and warm-up portion of the program.

At the completion of the second exercise session, the cool-down for the girl section, which would have just completed the skill development portion of their class period, would take place in location in the skill development area. Sections one and two would not meet as a group at the end of each class. The physical education faculty and staff assigned as instructors for each Form class would be responsible for taking a silent roll during the warm-up and stretching exercises of the Timed-X program.

The schedule for each individual class period during the week followed an outlined time sequence as indicated below.

The schedule the Committee agreed upon was:

00:00-00:05  Silent roll during Timed-X warm-up and stretching (sections one and two)
00:05-00:20  Timed-X exercise portion (section one/girls)
             Skill development (section two/boys)
00:20-00:25  Timed-X cool-down and transfer to skill development area (section one/girls)
Transfer from skill development area to Timed-X area (section two/boys)

00:25-00:40 Timed-X exercise portion (section two/boys)

Skill development (section one/girls)

00:40-00:45 Timed-X cool-down and final instructor comments (section two/boys)

Skill development cool-down and final instructor comments (section one/girls)

The Timed-X program was introduced to the students in the following manner.

Week One

Day One:

I demonstrated the Timed-X program to the students and committee members as all of them listened to the verbal instructions given on the audio tape. The students were not given the opportunity to ask questions. No other auditory or visual input was given.

Following the demonstration the students were informed that they would be participating in the Timed-X program. They were informed that they would receive more instructions in their next class period. The students went to the outdoor physical education area for skill development.

I assisted the committee members in learning the individual stretching and Timed-X exercises. This was done for two purposes. First, to let the committee members experience the motor patterns and degree of ease and/or
difficulty of the movements. Second, to provide the committee members with corrective teaching cues concerning the proper technique of each stretching or Timed-X exercise movement.

Day Two:

The physical education department chairman divided the students into two sections. The girls were assigned as section one and the boys as section two. The students were informed that they would meet together each class period in the Timed-X area for roll taking and stretching. The students were further informed that they would participate in the Timed-X exercises and their skill development as sections. Following roll call, along with the assistance of the available committee members, I taught the students the individual motor patterns for each stretching exercise. The girls section stayed in the Timed-X area and were taught the individual motor patterns for each of the Timed-X exercises by selected members of the committee. The remaining committee members went to the outdoor physical education area for skill development with the boys section.

Following the same time regimen established by the committee for the Timed-X program, the boys section left the outdoor physical education area and came to the Timed-X area while the girls section was completing the cool-down following their Timed-X exercise instructional period. The girls section, along with the committee members assigned to their section, left the Timed-X area for the outdoor physical education area and the skill development portion
of the class period. The program developer and the physical education department chairman and I stayed in the Timed-X area and taught the Timed-X exercise motor patterns to the boys section. We were assisted by the committee members who had initially been assigned to the boys section. Students in both sections cooled-down in their own individual sections as outlined in the time schedule provided by the committee. The students were informed that in their next class period they would participate in the Timed-X exercise program.

At the completion of day two all students had received instruction in each of the motor skills involved in the stretching and Timed-X exercises. In addition, all committee members had participated in the instruction of those motor patterns.

Day Three:

Students from both sections assembled in the Timed-X area and were ushered by committee members to designated areas. Students in the girls section were seated nearest the placement of the dual cassette player from which the Timed-X program would be played. Students in the boys section were seated nearest the entry to the Timed-X area. The committee determined this would best facilitate the boys section moving to the outdoor physical education area for skill development. The students in both sections were seated facing the side of the room where the dual cassette player was located.
I was seated facing the girls in section one. The physical education department chairman was seated facing the boys in section two. The Timed-X audio cassette was started. The physical education department chairman and I followed the instructions on the Timed-X audio cassette and provided a visual picture of the warm-up and stretching exercises. The students followed the instructions on the Timed-X audio cassette. The additional committee members assisted students, within the sections they had been assigned, in following the warm-up and stretching exercises with the motor patterns taught in the previous day's class period.

Following the warm-up and stretching portion of the Timed-X audio cassette, the boys section, with the committee members assigned to it, left for the outdoor physical education area and the skill development portion of the class. The Timed-X audio cassette continued without pause. The girls section began the first exercise on the Timed-X audio cassette while the boys section were leaving the Timed-X area. The program developer followed the Timed-X audio cassette providing a visual demonstration for the girls section. This was their first attempt at the Timed-X exercises at a high-intensity pace. The physical education department chairman and the other committee members assigned to the girls section assisted students in following the correct motor patterns of the Timed-X exercises. The girls completed the Timed-X exercise program and were cooling-down when the boys from section arrived. The transition--of moving the girls section, from the Timed-X program to skill
development, and of the boys section, from skill development to the Timed-X program—went smoothly. The transition was aided by the committee members assigned to the two sections. All movement of the two sections between the Timed-X area and the outdoor physical education area were within the time limitations established by the committee.

The physical education department chairman followed the Timed-X audio cassette, providing a visual demonstration of the Timed-X exercises the boys section were attempting for the first time at high-intensity pace. Along with the other committee members assigned to the boys section, I assisted students in following the correct motor patterns of the Timed-X exercises introduced in the previous class period.

The boys section completed the Timed-X exercise program and cool-down. The girls section completed a cool-down in the outdoor physical education area. Both sections of students were informed that they would be continuing this format and the Timed-X program each physical education day.

Summary of Week One:

It was interesting to me that many of the students simply stopped participating when they got tired. They seemed to feel no uneasiness at stopping or peer pressure to continue. They would occasionally use laughter at themselves or a friend as an excuse to stop exercising. Verbal motivation was not very effective. I approached one of the instructors about my concerns with the students stopping. His response was, "they are just tired." I could see that I had not fully communicated the purpose
and philosophy of the program to even the instructors or even more frightening was that I had communicated it and it just did not matter. The pace in Kiribati is so slow that it makes even a turtle seem intolerably vivacious. There were times when I was trying to motivate the students to work harder that I felt as though I were acting hysterically. I had concerns at this point about whether the students would exercise hard enough to receive the benefits of the program.

Week Two

Day Four:

The students came to the Timed-X area and were again ushered to their designated warm-up and stretching site. The Timed-X audio cassette began and class roll was taken while the students went through the warm-up and stretching exercises. A committee member assigned to the girls section was positioned in front of both sections and provided the live demonstration of the Timed-X warm-up and stretching exercises. Following the separation of the two sections the committee member who had provided the visual demonstration of the Timed-X warm-up and stretching exercises continued the visual demonstration throughout the entire Timed-X exercise and cool-down program for the girls section. The physical education department chairman and I assisted the students in the motor patterns of the Timed-X exercises and provided encouragement for those students finding individual exercises difficult or exhaustive. Following the completion of the Timed-X exercise and cool-down period for the girls section, the committee member assigned to the girls
section went with the girls section to the outdoor physical education area for skill development training.

A committee member assigned to the boys section provided the visual demonstration of the Timed-X exercises and cool-down. The physical education department chairman and I assisted the students in the motor patterns of the Timed-X exercises and provided encouragement for those students finding individual exercises difficult or exhaustive, as they had done for the girls section. During the cool-down segment at the conclusion of the Timed-X exercises, each section was praised for their effort and challenged to reach for higher individual effort during the entire duration of the Timed-X program.

At the conclusion of day four, all members of the committee (with the exception of the Principal) had physically led at least one section of the Timed-X program. The students had completed their second day full participation in the Timed-X program.

Day Five:

The Timed-X program was followed on day five as on day four with a member of the committee participating with the students. The committee member was again positioned facing the class with back to the dual cassette player/recorder.

Special Note: All committee members participating as a visual model of the program performed the motor patterns mirrored to the students. For example, if the Timed-X audio cassette instructed "right leg out," the committee member modeling the motor
pattern would place the left leg out. This would give the students facing the committee member a mirrored effect. It was decided by the committee that this would assist the learning process for the students.

Many of the students were now able to perform the exercises without thinking about the motor patterns. This allowed committee members to encourage students to increase the intensity level of their performance. Some students were now beginning to identify the name of the Timed-X exercise with the motor patterns of that exercise. This recognition aided the committee in assisting the students to be prepared for each upcoming Timed-X exercise following the third set of each program exercise.

Some students, on selected exercises, were now beginning to identify a specific number of repetitions per set. This identification appeared to the instructor to be a positive internal motivator for maintaining a consistent or higher number of repetitions as each set of three exercises were being performed. At the conclusion of day five, each committee member (with the exception of the Principal) had physically led at least two sections of the Timed-X exercise program with selected committee members having led as many as five. The instructors were becoming more confident in leading and advising the students with respect to the program.

Day Six:

The students were now coming to the Timed-X area and taking the positions for warm-up and stretching without committee member assistance.
The initial excitement of the "new" program was wearing off and the buzzing of close quarter communication was now becoming a quiet air of anticipation (particularly among the girls section that was to perform the Timed-X program first) as the beginning of the Timed-X exercise program approached.

The committee members were looking forward to their turn to physically lead a section and, in some cases, were competing with students for the highest number of correctly performed repetitions of selected exercises. Each day more students seemed familiar with the motor patterns and were showing progress in increasing repetitions of individual exercises during the 10-second exercise interval.

At the conclusion of the second week (day six) of the Timed-X implementation at the Moroni High School the program was beginning to be thought of as "our program" rather than the "I-Matang’s" (white-skinned or foreigners) program.

Summary of Week Two:

The program was beginning to take hold. The students initial response of disbelief about the workload was being replaced with a confidence to complete the program and even compete against one another. This was particularly true of the boys. Only among the very athletic of the girls was a willingness to work hard throughout the entire 15-minute program demonstrated. My concerns of a week ago about the low intensity level of the students was slowly leaving. A reasonable percentage of the boys were working at a high-intensity level and I began to consider
that perhaps the program may be better suited for boys than girls. When I developed the program I assumed it could be used with equal success by boys or girls. I knew that the program (philosophy) was equal and fair to all participants, boys or girls, but was now less sure about the selection of exercises. I had chosen the exercises based on my personal experience and the exercise potential for maintaining a target or training level heart rate. The program had been tested using male subjects and I wondered whether certain exercises were as well suited to women as they were to men. Specifically I was concerned about V-ups, triangle push-ups, and kangaroo hops. These three exercises had the lowest level of active participation from the girls.

Week Three

Day Seven:

The students entered the Timed-X area without any committee member assistance or directive. The students were left to themselves to find their appropriate section and seating location. The Timed-X audio cassette was started without any verbal communication from any committee member. There was no committee member assigned to physically lead the Timed-X warm-up, stretching, or exercises in any section or form. The students were presented, for the first time during their experience of the Timed-X program, with a learning environment that did not include any instructor to visually follow.
Following the separation of the boys section to the outdoor physical education area, for skill development, the committee members assigned to the Timed-X area continued in assisting the students with motor pattern correction. The committee also continued, in non-verbal gestures and means, to encourage the students to exercise at high intensity. Some students were slow to respond to the verbal commands from the audio tape without any instructor to follow during the change of Timed-X exercises. The change of exercises which occurs every minute allows no additional time beyond the ten seconds spaced between each exercise set. Other students, having cataloged the order of Timed-X exercises, were physically preparing for the next exercise before the Timed-X audio cassette prompted them with instructions.

Many students seemed unsure of the next Timed-X exercise without the committee member to visually depend upon. These students looked around to their classmates and, with an air of recognition, quickly prepared for the next exercise. Similar results were seen when the boys section replaced the girls section and the Timed-X exercise and cool-down program was conducted. Day seven ended with students having experienced the need for greater personal responsibility in ensuring a successful exercise bout.

Day eight:

The students entered the Timed-X area without any committee member assistance or directive. The students were left to themselves to find their appropriate section and seating location. A committee member, the permanent
instructor assigned to the girls section, was positioned to physically lead the Timed-X program when the students entered the Timed-X area. Only one other committee member, the permanent instructor assigned to the boys section, was participating in class. The committee member assigned to the boys section took the silent roll while the committee member assigned to the girls section, without speaking, led both sections through the warm-up and stretching exercises on the Timed-X audio cassette. The committee member assigned to the boys section left for the outdoor physical education area with the boys section. The committee member assigned to the girls section continued to physically lead the Timed-X exercises during the Timed-X audio program.

The physical education department chairman and I were seated in the back of the room as silent observers and did not participate in any way in the Timed-X program. The instructor physically leading the Timed-X exercises was the only committee member participating in the program. The instructor was responsible for leading the exercises and providing all supplemental(non-audio tape) motivation as well as any discipline that may have become necessary.

The committee member assigned to the girls section became their personal class instructor and went with them to the outdoor physical education area for skill development when the Timed-X cool-down was completed. The committee member assigned to the boys section, and who had just completed
skill development portion of the class with the boys section, came to the Timed-X area with the boys section and physically led the boys section through the Timed-X exercises and cool-down. At the end of day eight the students now recognized one instructor as their instructor and each class was staffed as it would be during the coming academic year.

Day nine:

Day nine was administered similarly to day eight with the following change. The committee member assigned as the instructor for each section did not physically lead any portion of the Timed-X program. The instructor acted as a roving trouble shooter, a motivator, a technique and motor pattern expert, and a disciplinarian, if necessary.

Summary of Week Three:

Following the final day of the Timed-X physical fitness program, under my supervision, I felt satisfied and also concerned. I was pleased with the support of the school administration, the committee members and the students. I was satisfied that I had done all I could during the four weeks to initiate the implementation of the program. I was concerned about problems, yet to come up, that I had not anticipated and how they would be handled. I suppose it was a fear that comes from being out of control and putting in someone else’s hands the outcomes of something in which I had placed great personal value.
Committee Concerns

During the implementation of the Timed-X program into the curriculum of the Moroni High School, two areas of concern were identified by committee members and other school faculty. The first area of concern was the physical effects of the Timed-X program on the students, and the second area was the intellectual or academic effects of the Timed-X program on the students.

The physical effects of the program became a concern of both committee and non-committee members in that students were unable to shower or change clothes following the Timed-X program. The intensity of the new program produced a higher level of exertion and higher rates of perspiration. There were some faculty who questioned whether the projected gain in physical fitness was worth the experienced loss in classroom focus and attire. The physical effects of the Timed-X program at Moroni High School are related to the national water supply, the facilities of the school itself and the finances and traditions of the people.

Water is a sacred resource in Kiribati. There is limited water available from wells. All other water is collected on rooftops and selected locations during the brief periods of precipitation. Many people in Kiribati bath in the ocean. It would be considered both unnecessary and wasteful to shower from collected or well water daily. Those residents who do not bathe in the ocean often sponge bath using very little water. The Moroni High School does not have a facility for physical education where lockers, showers, or even space to change clothes are available. The only shower or non-ocean water areas are within the living areas of the boarding students.
There are even times of the year (during extended droughts) when limitations must be placed on drinking water. These water limitations coupled with the time schedule established by the committee made any type of shower difficult.

Students at the Moroni High School, as in all other schools in Kiribati, follow in the tradition of the British system which established Kiribati's educational program. Uniforms were required for both boys and girls. The availability of clothing specifically for physical education was a luxury many could not afford. The school had made no provision for physical education clothing and had no plans to budget for it in the near future.

The students, then, participated in the Timed-X and all other physical education programs (i.e. skill development, etc.) wearing the school uniforms they were required to purchase for attendance at the school. The uniforms for boys were blue shorts and a white button-down, short sleeve shirt. The girls wore blue skirts, mid-calf length, and a white button-down, short sleeve shirt.

Following a strenuous physical education class, students were required to go directly to their next class without showering or even changing clothes. There were some exceptions among the boys boarding at the school. Occasionally students would quickly run back to dorm to sponge bath and change shirts before the next class. They were often late. When the students arrived in their next class, they were hot, often still perspiring and wearing wet and sticky clothes. Body odor occasionally became a problem with students who had only one uniform and were unable to wash it every day. The boys, or section two in each Form, participated in the Timed-X
program following the girls and left immediately from the Timed-X area to their next academic class. The problem of wet clothing and continued perspiration was greatest among this group of students.

The second major concern among committee members and other school faculty was the academic or intellectual effect the Timed-X program had on the students in Forms I-III. It was felt, particularly during week two, that the students were so exhausted in the class immediately following physical education that the individual learning environment was unsatisfactory. It was reported, in selected cases, that students in afternoon classes, having had physical education before their lunch break, were falling asleep.

It was the initial response of the non-committee faculty and even some members of the committee that the program was too strenuous and exhaustive for the I-Kiribati. Although these concerns were appropriate in this educational setting, the committee had received the support of the administration and faculty in allowing the Timed-X program to continue.

During the third week, the students began adjusting to the Timed-X program. They appeared less exhausted following the physical education class and experienced, in some cases, an increased attentiveness attributed to the program. As the implementation period continued, the students began experiencing strength and endurance gains. Their muscle tone and body definition began changing. It was during this slow consistent period of physiological adaptation to the program that both
committee and non-committee members commented on what they believed to be increases in individual confidence among participating students.

The administration and faculty seemed pleased with the progress notwithstanding their concerns. During the remaining weeks of the first term and the second term of the implementation, some interesting observations were made by committee members. The feelings and attitudes expressed in these observations were given to me through the physical education chairman at the school. He and his staff felt that the students' self-confidence was increasing. They seemed to feel better about themselves. The staff seemed to think that the students walked with shoulders back and heads held higher than before. Speaking personally, I know it is difficult to explain and harder to measure, but I can tell you whether a people project the image of a champion or not without speaking to them. An example of this is the bullfighter. He has perhaps the most arrogant and yet confident walk of any athlete I have seen. I certainly do not think that these students were walking like bullfighters, but to be walking with shoulders back and head up is a marked change for many Micronesians. I was pleased that the school continued their support in allowing the Timed-X program enough time to produce changes which could be seen by others and be measured by some.
CHAPTER IV
PRESENTATION AND ANALYSIS OF DATA

The purpose of this study was to develop, field test, and implement a model high school physical fitness program. The development of the physical fitness program, designated Timed-X, is found in chapter three. There was no quantitative data to gather or analysis to be performed on the development of the Timed-X program. The field testing of the Timed-X program was to determine the effects on aerobic capacity and body composition following eight weeks of participation in the program. The Timed-X program was then implemented in the Moroni High School in Tarawa, Kiribati. Results of the Implementation process will follow the presentation of the analysis of data with respect to the field testing of the Timed-X physical fitness program.

Field Testing

The subjects participating in the field testing phase of this study consisted of volunteer missionaries for The Church of Jesus Christ of Latter-Day Saints who were undertaking an eight week cultural and language training experience at the LDS Missionary Training Center in Provo, Utah. Subjects were selected randomly, from those preparing to minister in Japan, and placed into one of the two test (Timed-X or jogging) groups or a control group. Previous physical activity, levels of fitness, or body composition were not considered in the selection process. Pre- and post-tests, to measure aerobic capacity and body composition, were administered at the beginning
and at the end of the eight week participation period. An analysis of variance was used to determine significant changes resulting from the tests.

1.5 Mile Run

Table 1 includes the pre- and post-test results of the 1.5 mile run for the Timed-X test-group. The pre-test times ranged from a low of 519 seconds (8:39) with Timed-X subject number one, to a high of 972 seconds (16:12) with Timed-X subject number thirteen. The post-test times ranged from a low of 507 seconds (8:27) to a high of 788 seconds (13:08) with the same subjects recording the end range scores for both pre- and post-tests. The cumulative total for the twenty Timed-X test-group subjects pre-test was 12,891 seconds. The cumulative total for the same groups post-test was 12,351 seconds. The difference of 540 seconds showed an average decrease of 27 seconds. The greatest decrease shown was that of subject number thirteen who reduced his time by 184 seconds from 972 (16:12) to 788 (13:08). This reduction of over three minutes constitutes the greatest percentage drop among all participants at 19%. Of the twenty Timed-X test-group subjects, 18 showed a decrease in time while 2 added time to their pre-test scores. The greatest increase in time came from subject number six whose time of 563 seconds (9:23) elevated 34 seconds to 597 (9:57). Figure 1 is a comparison of changes in fitness categories, according to Cooper (14) (see appendix J), from pre- to post-test in the 1.5 mile run. Fitness category changes were seen in six of the Timed-X test-group participants. Five of the subjects increased one fitness category. Two progressed from an
Table 1. Pre- and post-test results of the 1.5 mile run for the Timed-X test-group

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Pre-test = 12,891 seconds
Post-test = 12,351 seconds
difference = 540 seconds
divided by 20 = -27 seconds average
excellent to a superior rating, one from good to excellent, one from fair to good, and one from very poor to poor. Fourteen subjects maintained the same fitness level.

One subject dropped a fitness level from excellent to good.

**Figure 1. A comparison of changes in fitness categories* for pre- to post-test in the 1.5 mile run for the three groups.**

![Bar chart showing changes in fitness categories](image)

*Based on Cooper's Chart (see Appendix J)

Table 2 includes the pre- and post-test results of the 1.5 mile run for the jogging test-group. The pre-test times ranged from a low of 495 seconds (8:15) with
Table 2. Pre- and post-test results of the 1.5 mile run for the jogging test-group

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Pre-test = 12,364 seconds
Post-test = 11,778 seconds
difference = 586 seconds
divided by 20 = -29.3 seconds
subject number thirteen to a high of 867 seconds (14:27) with subject number nine. The post-test times range from a low of 468 (7:48) to a high of 719 (11:59) with the same subjects recording the end range scores for both pre- and post tests.

The cumulative total for the twenty jogging test-group subjects pre-test was 12,364 seconds. The cumulative total for the same group’s post-test was 11,778 seconds. The difference of 586 seconds showed an average decrease of 29.3 seconds. The greatest decrease shown was that of subject number nine who reduced his time by 146 seconds from 867 (14:27) to 719 (11:59). Of the twenty jogging test-group subjects 18 showed a decrease in time while 2 added time to their pre-test scores. The greatest increase in time came from subject number eighteen whose time of 564 seconds (9:24) elevated 4 seconds to 568 (9:28).

Five of the jogging test-group subjects increased one fitness category. Two subjects moved from excellent to superior, two from good to excellent, and one from poor to fair. Fifteen participants in the jogging test-group remained in the same fitness category. No participants in the jogging test-group dropped a fitness level according to Cooper’s categories. (see Figure 1)

Table 3 includes the pre- and post-test results of the 1.5 mile run for the control group. The pre-test times ranged from a low of 510 seconds (8:30) with control group subject number four, to a high of 879 seconds (14:39) with control group subject number twelve. The post-test times ranged from a low of 531 seconds (8:51) to a high of 870 seconds (14:30) with the same subjects recording the end range scores for both pre- and post-tests.
Table 3. Pre- and post-test results of the 1.5 mile run for the control group

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Pre-test = 12,891 seconds  
Post-test = 12,351 seconds  
difference = 540 seconds  
divided by 20 = -27 seconds

80
The cumulative total for the twenty control group subjects pre-test was 12,677 seconds. The cumulative total for the same group’s post-test was 12,565 seconds. The difference of 112 seconds showed an average decrease of 5.6 seconds. The greatest decrease shown was that of subject number twenty who reduced his time by 124 seconds from 745 (12:25) to 621 (10:21). Of the twenty control group subjects 13 showed a decrease in time while 7 added time to their pre-test scores. The greatest increase in time came from subject number five whose time of 807 seconds (13:27) elevated 18 seconds to 825 (13:45).

Interestingly, the difference in time by control group subject number twenty (124 seconds) exceeded the total difference of the remaining control group subjects (112 seconds).

Fitness categories remained constant in 17 of the 20 subjects (see figure 1) while 3 subjects changed fitness categories. Two subjects dropped one fitness category and one subject increased two categories.

Table 4 contains the statistical results of the comparison of differences between pre- and post-test (delta) scores of the 1.5 mile run time between the control, jogging, and Timed-X groups.

Table 5 shows the means and standard deviations of pre- and post-test of the 1.5 mile run for all three treatment groups, as well as the delta scores for each group. Data analysis shows that all three treatment groups had various degrees of improvement in the 1.5 mile run time after eight weeks of treatment. However, the improvement seen in the jogging and Timed-X treatment groups were significantly
Table 4. Analysis of variance between the pre- and post-test differences (delta scores) for the 1.5 mile run between the three groups.

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This calculated F value of 3.021 is significant at the 0.0551 level.

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<th>St. Dev.</th>
<th>St. Dev.</th>
<th>Number</th>
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<td>5.600</td>
<td>29.708</td>
<td>28.956</td>
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<tr>
<td></td>
<td>*Confidence interval is from -9.731 to 20.931 at the 0.05 level.</td>
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<td>30.178</td>
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<tr>
<td></td>
<td>*Confidence interval is from 13.969 to 44.631 at the 0.05 level.</td>
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<td>27.000</td>
<td>41.043</td>
<td>40.004</td>
<td>20</td>
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<tr>
<td></td>
<td>*Confidence interval is from 12.669 to 43.331 at the 0.05 level.</td>
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</tbody>
</table>

The calculation of the confidence intervals uses the values from the chart of the MS Within and DF Within.

MEAN for all individuals = 20.967

Confidence interval of the difference is:

- Comparing group 1 with group 2: From 2.02 To 45.38 Significant
- Comparing group 1 with group 3: From 0.72 To 44.08 Significant
- Comparing group 2 with group 3: From -20.38 To 22.98

HERE ARE THE ABSOLUTE t-TEST SCORES FOR ALL GROUPS

<table>
<thead>
<tr>
<th>GROUP</th>
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The Duncan Multiple Range Tests show the following:

- Group 1 with a mean of 5.600
- and Group 3 with a mean of 27.000 significantly different, 0.05 level
- Group 1 with a mean of 5.600
- and Group 3 with a mean of 29.300 significantly different, 0.05 level
greater than the control group when their delta scores were compared, \( F(2, 57) = 3.021, p < 0.05 \). There was no significant difference between the jogging and Timed-X test-groups. The average improvement was 5.6 seconds for the control group, 29.3 seconds for the jogging test-group and 27 seconds for the Timed-X test-group, respectively.

Table 5. 1.5 mile running time prior to and post 8 weeks of treatments

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Pre-test (sec)</th>
<th>Post-test (sec)</th>
<th>Delta score (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n=20)</td>
<td>633.9 ± 92.7</td>
<td>628.3 ± 86.4</td>
<td>5.6 ± 29.7</td>
</tr>
<tr>
<td>Jogging (n=20)</td>
<td>618.2 ± 78.0</td>
<td>588.9 ± 58.6</td>
<td>29.3 ± 30.9</td>
</tr>
<tr>
<td>Timed-X (n=20)</td>
<td>645.1 ± 104.2</td>
<td>617.1 ± 73.2</td>
<td>27.0 ± 41.0</td>
</tr>
</tbody>
</table>

**Significant Duncan Contrasts (p<0.05)**

Body Composition

Table 6 includes the pre- and post-test results of the body composition evaluation for the Timed-X test group. The pre-test individual totals ranged from a low of 27 mm with subject number seven to a high of 83 mm with subject number thirteen. The post-test individual totals ranged from a low of 25 mm with subjects number three, seven, and twenty to a high of 71 mm with subject number thirteen. The cumulative total for the twenty Timed-X test-group subjects pre-test was 760
Table 6. Pre- and post-test results of the body composition evaluation for the Timed-X test-group.

<table>
<thead>
<tr>
<th>Sub.</th>
<th>Pre-Test</th>
<th></th>
<th>Post-Test</th>
<th></th>
<th>Δ</th>
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</thead>
<tbody>
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<td>Abd.</td>
<td>Thigh</td>
<td>Tot.</td>
<td>Chest</td>
</tr>
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</tbody>
</table>

Pre-test = 760
Post-test = 664
difference = 96
average loss = 4.8
average = 38/33.2
mm. The cumulative total for the same groups post-test was 664 mm. The difference of 96 mm showed an average decrease of 4.8 mm. The average individual pre-test total was 38 mm with the post-test score 33.2 mm. The greatest decrease shown was that of subject number four, who reduced his pre-test total of 52 mm by 13 mm to 39 mm on the post-test. This represents decrease of 25% of the subjects total body fat as determined by the skinfold evaluation. Of the twenty Timed-X test-group subjects, all twenty showed a decrease in millimeters of skin tested during the post-test skinfold evaluation. No subjects in the Timed-X test-group increased or remained the same in millimeters of skin recorded during the testing of body composition through the skinfold evaluation.

Table 7 includes the pre- and post-test results of the body composition evaluation for the jogging test-group. The pre-test individual totals ranged from a low of 19 mm with subject number thirteen to a high of 74 mm with subject number nine. The post-test individual totals ranged from a low of 20 mm to a high of 60 mm with the same subjects recording the end range scores.

The cumulative total for the twenty jogging test-group subjects pre-test was 714 mm. The cumulative total for the same groups post-test was 654 mm. The difference of 60 mm showed an average decrease of 3 mm. The average individual pre-test total was 35.7 mm with the post-test score 32.7 mm. The greatest decrease shown was that of subject number nine who reduced his pre-test total of 74 mm by 14 mm to 60 mm on the post-test. This represents a decrease of 18.92% of the subjects total mm of skin as determined by the skinfold evaluation. Of the twenty
Table 7. Pre- and post-test results of the body composition evaluation for the jogging test-group

<table>
<thead>
<tr>
<th>Sub.</th>
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<td>Thigh</td>
<td>Tot.</td>
<td>Chest</td>
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</tr>
</tbody>
</table>

Pre-test = 714  
Post-test = 654  
Difference = 60  
Average loss = 3  
Average = 35.7/32.7
jogging test-group subjects, fifteen showed a decrease in millimeters of skin tested while two added millimeters of skin to their pre-test totals. Three of the subjects remained the same during the test period with respect to millimeters of skin tested in the body fat evaluation. The greatest increase in millimeters of skin came from jogging group subjects three and thirteen, whose pre-test totals of 30 and 19 respectively were each increased one to 31 and 20 on the post-test.

Table 8 includes the pre- and post-test results of the body composition evaluation for the control group. The pre-test individual totals ranged from a low of 26 mm with subject number nineteen to a high of 61 mm with subject number twelve. The post-test individual totals ranged from a low of 25 mm to a high of 58 mm with the same subjects recording the end range scores. The cumulative total for the twenty control group subjects pre-test was 745 mm. The cumulative total for the same groups post-test was 741 mm. The difference of 4 mm showed an average decrease of 0.2 mm. The average individual pre-test total was 37.25 mm with the post-test score 37.05. The greatest decrease shown was that of subjects number twelve and eighteen who reduced their pre-test totals of 61 and 32 respectively by 3 mm to 58 and 29 on the post-test. Of the twenty control group subjects eight showed a decrease in mm of skin tested while six added mm of skin to their pre-test totals. Six of the subjects remained the same during the test period with respect to mm of skin tested in the body composition evaluation. The greatest increase in mm of skin came from control group subjects two and five whose pre-test totals of 33 and 54 respectively were each increased by 3 to 36 and 57 on the post-test.
Table 8. Pre- and post-test results of the body composition evaluation for the control group

<table>
<thead>
<tr>
<th>Sub.</th>
<th>Pre-Test</th>
<th>Post-Test</th>
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</tr>
</thead>
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</table>

Pre-test = 745  
Post-test = 741  
Difference = 4  
Average loss = 0.02  
Average = 37.25/37.05
Table 9 contains the statistical results of the comparisons of differences between the pre- and post-test (delta) scores of the body composition measurements between the control, jogging, and Timed-X groups.

Table 10 shows the means and standard deviations of pre- and post-test of the body composition measurements for all three treatment groups, as well as the delta scores for each group. Data analysis shows that all three treatment groups had various degrees of improvement with respect to lowering body fat following eight-weeks of treatment. However, the improvement seen in the jogging and Timed-X treatment groups were significantly greater than the control group when their delta scores were compared, \( F(2,57) = 11.771, \) \( p < 0.05 \). There was no significant difference between the jogging and Timed-X test groups. The average decrease was 0.2 mm for the control group, 3.0 mm for the jogging test-group, and 4.8 mm for the Timed-X test-group respectively. When viewed from a perspective of percentage of total mm of skin lost as a result of the treatment, the control group lost one-half of one percent (0.005) of their total mm of skin, the jogging group lost nearly eight and one-half percent (0.084) of their total mm of skin, while the Timed-X test-group lost over twelve and one-half percent (0.126) of their total mm of skin.

Summary

Although statistically speaking the Timed-X physical fitness program and jogging appear to produce similar results there are some additional observations worth noting. The evaluation for aerobic capacity was running which the jogging group participated in daily. This may have provided an advantage in training not considered
Table 9. Analysis of Variance between the pre- and post-test differences (delta scores) for the body composition (skinfold) test between the three groups.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
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<tr>
<td>BETWEEN</td>
<td>2</td>
<td>214.93</td>
<td>107.41</td>
<td>11.771</td>
</tr>
<tr>
<td>WITHIN</td>
<td>57</td>
<td>520.40</td>
<td>9.13</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>59</td>
<td>735.33</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

This calculated F value of 11.771 is significant at the 0.0002 level.

Sample Population

<table>
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<tr>
<th>Group</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>St. Dev.</th>
<th>Number</th>
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</thead>
<tbody>
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<td>0.200</td>
<td>1.735</td>
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<td></td>
<td>*Confidence interval is from -1.151 to 1.551 at the 0.05 level.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>3.000</td>
<td>3.418</td>
<td>3.332</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>*Confidence interval is from 1.649 to 4.351 at the 0.05 level.</td>
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<td></td>
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</tr>
<tr>
<td>3</td>
<td>4.800</td>
<td>3.563</td>
<td>3.473</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>*Confidence interval is from 3.449 to 6.151 at the 0.05 level.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The calculation of the confidence intervals uses the values from the chart of the MS Within and DF Within.

MEAN for all individuals = 2.667

Confidence interval of the difference is:

Comparing group 1 with group 2: From 20.89 to 4.71 Significant
Comparing group 1 with group 3: From 32.69 to 6.51 Significant
Comparing group 2 with group 3: From 3-0.11 to 3.71

HERE ARE THE ABSOLUTE t-TEST SCORES FOR ALL GROUPS

GROUP  | 2 | 3
1      | 3.267 | 5.191
2      | -    | 1.630

The Duncan Multiple Range Tests show the following:

Group 1 with a mean of 0.200
and Group 3 with a mean of 3.000 significantly different, 0.05 level
Group 1 with a mean of 0.200
and Group 3 with a mean of 4.800 significantly different, 0.05 level
Table 10. Body Composition
(skinfold) measurements prior to and post
8-weeks of treatments

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Pre-test (mm of skin)</th>
<th>Post-test (mm of skin)</th>
<th>Delta score (mm of skin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n=20)</td>
<td>37.3 ± 9.0</td>
<td>37.05 ± 8.9</td>
<td>0.2 ± 1.7</td>
</tr>
<tr>
<td>Jogging (n=20)</td>
<td>35.7 ± 11.1</td>
<td>32.5 ± 8.8</td>
<td>3.0 ± 3.4</td>
</tr>
<tr>
<td>Timed-X (n=20)</td>
<td>38.0 ± 12.3</td>
<td>33.2 ± 10.0</td>
<td>4.8 ± 3.6</td>
</tr>
</tbody>
</table>

***Significant Duncan Contrasts (p<0.05)

in the results. The Timed-X physical fitness test-group was very close to the jogging test-group in average decrease in seconds per subject. The difference of 2.3 seconds from the 29.3 seconds for the jogging test-group and 27 seconds for the Timed-X physical fitness test-group represents only an additional 8.5 percent decrease. The skinfold results of the two test-groups, although still not statistically significant, show much greater variation. The difference in average decrease in mm of skin from 3.0 for the jogging test-group to 4.8 for the Timed-X test-group represent an additional decrease of 60 percent. That is 7 times the difference noted above from the 1.5 mile run results.

The null hypothesis that there were no significant differences on the 1.5 mile run time and body composition between the Timed-X and control groups is rejected. The analysis of variance verified that there is a significant difference on both the 1.5 mile run time and body composition between the Timed-X and control groups at the .05 level. The null hypothesis that there were so significant differences on the 1.5
The analysis of variance confirmed no significant differences on the 1.5 mile run and body composition between the Timed-X and jogging groups at the .05 level.

Implementation

The results from the implementation of the Timed-X physical fitness program at the Moroni High School in Tarawa, Kiribati, were not statistically verifiable. The Timed-X program was implemented as described in Chapter III and followed identically the outlined version listed in the development section in Chapter III and as contained on the audio tape. Other results, however, are worth noting.

Each year, high school athletic championships are held in Bikenibeu at the King George V and Elaine Bernacchi School. Competition is held in athletics (track and field), basketball, and football (soccer). Prior to the implementation of the Timed-X physical fitness program at the Moroni High School, the government schools located in Bikenibeu had won each of the three team events for both boys and girls every year since the competition’s inception.

The Moroni High School had never finished in the top three in any of the boys competitions and their highest finish among the girls was third place in track and field two years earlier. In the first year of competition following the implementation of the Timed-X physical fitness program, the Moroni High School girls track and field team were the Kiribati National High School Champions. The Moroni High School boys track and field team finished as Kiribati National High School Runner-ups, second to King George V, although they had won more first place events. The boys’ and girls’
soccer and basketball teams had identical results. Although they did not play for the National High School Championship, both the boys’ and girls’ teams in soccer and basketball made the semi-final round. It was the first time that any Moroni team had made the final four.

This type of recognition has been encouraging to the administration and given the school a source of pride.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The Timed-X physical fitness program is an equal and fair approach to high school physical fitness. The program allows each student to work at their own maximum pace. The program is based on 10 second periods of exercise alternated with 10 second periods of rest. The exercises are changed every minute, allowing 15 different exercises during the fitness workout. Stretching precedes and follows the exercises for warm-up and cool-down purposes. Exercises are rotated and include upper, mid- and lower body activities. The exercise periods of 10 seconds are equal for each student. The number of repetitions performed during each exercise period, although different for each student, represents a fair way of dealing with various levels of fitness. Two students, one evaluated in a superior fitness category and another in a very poor fitness category, can exercise side by side and both receive an excellent workout. For example, the student in the superior fitness category may be able to do 10 push-ups in each 10 second period of time, and the student in the very poor fitness category may only be able to do two or three push-ups. It may appear that the student doing the most repetitions is working hard and the student doing the fewest repetitions dogging it. One of the strengths of this program is that just the opposite may be the case. The determining factor in whether an acceptable workout has taken place is not the number of repetitions performed during the exercise intervals but whether the exercise heart rate was well within the target or training zone for cardiovascular strength gains to occur. This means, of course, that as you reach higher levels of fitness you must work harder. The Timed-X program
eliminates the possibility of coasting and allows dignity and self-worth to be achieved by participants of all fitness levels. A variety of exercises were chosen, many for their ability to elevate or maintain a heart rate, with the intention of challenging the major muscle groups of the entire body. The exercises were rotated in such a way as to avoid localized fatigue and it was intended that a similar number of repetitions would be achieved in each of the three 10-second work intervals for each exercise. A field test was conducted with sixty missionaries for The Church of Jesus Christ of Latter-Day Saints. The subjects were nineteen years of age and participating in an eight week language and culture orientation. There were twenty subjects in a control group and each of two test groups. One test group used the Timed-X program while the other test group jogged for the same period of time. The control group participated in a variety of recreational games such as half-court basketball or volleyball. Pre- and post-tests were administered in the 1.5 mile run and a skinfold test to determine body composition. Both test groups showed significant gains in each area when compared with the control group. There was no significant difference between the two test groups in either the 1.5 mile run or the skinfold test. These results show that a decrease in body fat and an increase in cardiovascular endurance can be achieved in a physical education setting in which students complete different workloads and compete only against themselves. The purpose of the field test was to verify that the escalating health risks associated with decreasing cardiovascular endurance and a rise in obesity could be slowed, stopped, or perhaps even reversed. Although flexibility and strength activities were a major part of the program, no testing in these areas took place. It was assumed that someone doing nine sets of
push-ups and nine sets of abdominal exercises a day would increase arm and abdominal strength when compared with someone who did none. All three treatment groups participated in stretching.

After the completion of the field test, and with the confidence that the program produced positive health-related fitness benefits, it was time to put the program into an actual high school. The Moroni High School on the atoll of Tarawa in Kiribati, a central Pacific nation, agreed to a trial implementation period of two terms. An implementation committee was formed to administer the program. It included the principal, the physical education faculty and staff, and myself. I stayed at the school for one month to make sure that the program was being run correctly and to oversee and troubleshoot problems and concerns as they came up. The program was implemented in Forms I, II, and III (British system designation for grade levels) only, where physical education was required of all students. I demonstrated the entire program from warm-up through cool-down for the committee members and then for each class. I held a session with just the instructors of the classes to make sure that they were performing the exercises and stretches in a safe and precise manner. Accuracy in performing (and therefore teaching) the motor patterns was important in isolating the specific muscle groups targeted by the program and in eliminating or lowering any risk of injury. In each class students were divided into two sections, one for boys and one for girls. This was done for purposes of modesty since all students were required to wear the school uniforms (skirts for girls) and there were no gym clothes or changing facilities available. The two sections met together at the beginning of class and then alternated between the Timed-X program and sport skill
fundamentals. The intensity of the program was much higher than the students were used to, and during the initial stages of implementation they often just stopped when they were tired. There were also times in the beginning when students were so tired after completing the Timed-X program that when they went to the sport skill area they just lay on the ground and rested or went to sleep. There were even instances where students fell asleep on their desks in their next class, which caused a few problems administratively. As they continued with the program, the students conditioning level increased. Their ability to maintain a high intensity for the full length of the program became easier, and many of the students eventually got to a level where they would complete the exercises and hurry to the sport skill area to be the first to participate in the activity of the day.

The implementation in Kiribati faced some challenges that I would not expect in a high school in the United States. The biggest challenge came from the lack of water. Kiribati relies on rainfall and a few wells for all its water needs. It is not uncommon for months to go by without a significant rainfall. Because of this, showering after a physical education class is just not a possibility. This created real problems with perspiration on uniforms and occasionally body odor. Most students could only afford one uniform, and washing it each day was not always possible. The water and uniform problem was something we had to face before, during and after class. No school-wide solution was arrived at, but many students began wearing shorts or t-shirts under their uniforms. They would take the shorts and t-shirts off after class.
The feedback from the physical education teachers was positive. Although they were apprehensive at first, and some actually did not believe that I-Kiribati were capable of enduring such a program (interesting the beliefs we create about ourselves), they found the students more confident, competitive, and excited about physical education. There was no quantitative evaluation at the conclusion of the implementation, but both the faculty and the administration felt the program was a success. Students were coming early to physical education, and the after-school optional sports participation increased dramatically. In the high school national sports competitions the school showed improvement in every sport and even won its first ever title, in girls athletics (track and field).

In summary, this physical fitness program, Timed-X, was developed as a fair and equal program for all participants. It was field tested and determined to be as effective as jogging for increasing cardiovascular endurance and decreasing body fat. It was implemented in a high school and found to be both fitness producing and compatible with time constraints and other motor and behavioral objectives.

I would recommend that an ACSM certified member go over all the exercises, both for stretching and fitness, and modify or replace any activity that may be a risk for injury. For example, since the program development, a shift in abdominal exercises has moved from the traditional curl-up or sit-up to what are called crunches. This type of modification will add strength to the content of the program. I also recommend that the program be expanded to include at least four levels of exercises. These levels should include, but not be limited to, special education, novel or introductory, intermediate, and competitive. They may even be labeled platinum,
gold, silver, and bronze flights, for example. A spin off of this program has been used by selected athletic teams with sport specific skills being used in place of some of the exercises. This has successfully been done with basketball, volleyball, and tennis. A short time ago I represented the United States Information Agency on a Sports America Program to Guyana in South America. While there, as a tennis expert, I consulted with most of the national coaching associations. The national cricket team (of which three members were on the West Indies world championship team) asked for some fitness conditioning. I took them through the Timed-X program, without any modification for cricket specific activities. They were pleased and felt that it was the most consistently challenging program they had ever done. Most coaches like the program because, even with teams like the Guyana national cricket team, there are always athletes who are not challenged by the exercises and activities that others can hardly do. If a four level program were developed, large charts and posters could be made which could hang on the walls of the gym where the workout was to take place, and students could select from exercises best suited to their specific needs. Another advantage of this concept is that it includes the on-site physical education teacher in making decisions for students who may need legitimate exceptions.

I would also recommend making a video-tape of the program. This would allow those experts making curriculum decisions to visually experience the program. They would then have the option, if equipment and facilities were available, to give their students an opportunity to see the program if they were unable to demonstrate it. My final recommendation is implementation in a U.S. high school.
A PHYSICALLY EDUCATED PERSON:

HAS learned skills necessary to perform a variety of physical activities

1. ...moves using concepts of body awareness, space awareness, effort and relationships.
2. ...demonstrates competence in a variety of manipulative, locomotor and non-locomotor skills.
3. ...demonstrates competence in combinations of manipulative, locomotor and non-locomotor skills performed individually and with others.
4. ...demonstrates competence in many different forms of physical activity.
5. ...demonstrates proficiency in a few forms of physical activity.
6. ...has learned how to learn new skills.

IS physically fit.

7. ...assesses, achieves and maintains physical fitness.
8. ...designs safe, personal fitness programs in accordance with principle of training and conditioning.

DOES participate regularly in physical activity.

9. ...participates in health enhancing physical activity at least three times a week.
10. ...selects and regularly participates in lifetime physical activities.

KNOWS the implications of and the benefits from involvement in physical activities.

11. ...identifies the benefits, costs and obligations associated with regular participation in physical activity.
12. ...recognizes the risk and safety factors associated with regular participation in physical activity.
13. ...applies concepts and principles to the development of motor skills.
14. ...understands that wellness involves more than being physically fit.
15. ...knows the rules, strategies and appropriate behaviors for selected physical activities.
16. ...recognizes that participation in physical activity can lead to multi-cultural and international understanding.
17. ...understands that physical activity provides the opportunity for enjoyment, self-expression and communication.

VALUES physical activity and its contributions to a healthful lifestyle.

18. ...appreciates the relationships with others that result from participation in physical activity.
19. ...respects the role that regular physical activity plays in the pursuit of life-long health and well-being.
20. ...cherishes the feelings that result from regular participation in physical activity.
Butterfly

Inside of upper thigh, lower groin, lower and middle back.

lower back

Middle & lower back

(a) Sit down with the bottom of feet against each other. Place the heels of your feet as close to your body as possible. Lean back placing hands palm down behind you. Lower knees slowly until they reach the ground simultaneously.

(b) Seated in same position, now place hands around toes or ankles and bring forehead to toes.

(d) Place arms around legs (in same position) so that inside of elbows are on the foot side of the knee. Hands come underneath legs and join near crotch area. Push out with the legs forcing the arms to pull the back, stretching the muscles in middle and lower part.
Trunk twist

stretches trunk and lower back

(a) sit in a half lotus (or lotus if you can) and rotate shoulders and trunk so that you face the other direction. Reverse for other side.

(b) with feet shoulder width apart, swing arms slowly from front to back (side to side) stretching trunk slowly.
Place left leg in front of you at right angle. Outside of knee and ankle will be touching the floor. Right leg is behind you with knee cap and top of foot on floor. With arms folded, lean down to left leg, then over to left foot, then arch back as far as you can, then reverse process on other leg.
Legs Together

back of legs from below knee to lower back. Also middle back.

(a) Sit down and place both legs flat on the ground with knees locked. Toes are pointed up and pulled back toward your chest. Inside of knees are together. Place your hands on your ankles and bring face to knees. Hold for at least 10 seconds. Repeat a minimum of 5 times.

(b) Sit in same position with toes pointed out and follow similar stretching procedure.

(c) Sit in same position with toes pointed in and follow similar stretching procedure.
Hang

back of legs from
below knee to lower back

Place feet together and keeping knees locked, place hands
on ankles and bring face to knees. 10 seconds. Minimum of 5.
Squat
(side to side)

inside of upper thigh,
calf

Sit in a squat. Throw your right leg out and put your weight on it. Both feet must remain flat and left leg locked. Reverse and continue at fairly rapid pace.
Hurdler

back of leg

front of thigh

(a) Sit down with left leg in front of you, knee locked and toes pointed up and pulled in. Right leg at 90° angle to left with inside of knee and ankle on floor. Place hands on the outside of left foot and bring face to left knee keeping knee locked.

(b) Then lean back first with weight on elbows and then all the way to shoulders. Right knee should remain on ground. Reverse process.
Side-split
inside of upper thigh

In seated position with left leg straight out in front of you, bring right foot so that sole of shoe is flat against chest. Reverse process for other leg.

Leg Spread

back of legs from knee to lower back; also middle back

Sit down and spread legs as wide as comfortably possible, keeping knees straight. Foot should be pointed up with toes pulled back towards body. Place palm side of right hand on the outside of the left ankle and gently lower your head to your left knee. Hold in that position (as close to your knee as you can, this may not be very close at all, but with continued effort it can be achieved) for as long as 10 seconds. Release, and follow same procedure on other leg. Place left hand on left ankle and right hand on right ankle and pull face towards floor in front of you. Remember knees must stay locked at all times.
Over on back

small of back, back of legs, neck.

neck

Lay down on back with arms straight out from body, palms down. Keeping knees locked and toes pointed out, bring feet over head and touch on ground above head. Walk with toes about six inches at a time to right hand then all the way back to the left hand.

(b) Bend knees and place them on floor next to ears.
Front leg bent back straight

Bend left leg to 90°, and right leg straight back. Drop hip to stretch groin, reverse for other leg.
Knee rotation

loosens up knees

Place feet shoulder width apart with hands on knees. Rotate knees in large, circular motion. Reverse motion.
One foot upon chest

Outside of upper thigh

Split legs sideways as far as is comfortably possible. Place hands on ground-in front of you, now split legs farther apart. Continue until limit is reached. Do for at least 1-2 minutes.
Ankle rotation

inside, outside, front
and back of ankle.

(a) Sit with one leg in front (straight)
the other bent with foot in hands. Rotate
ankle slowly. Reverse.

(b) Standing on all fours with 2/3 weight
on hands, rotate ankles first inward, then
outward.

(c) Standing with feet shoulder width, rise
up on the outside of both feet simultaneously.
Repeat 20 times.

(d) Standing with feet shoulder width, rise
up on the inside of both feet simultaneously.
Repeat 20 times.
Calf stretch

back of lower leg

Stand with hands against wall and feet about three or four feet away, heels flat on floor. Drop waist slowly toward floor, keeping heels on floor. (Also can be done one leg at a time.)
Shoulder Rotation

shoulder girdle

(a) Feet shoulder width apart. Shoulder square with feet. Swing right arm in circular forward manner around with hand coming in front of body. (not to the side) Swing slowly to begin with and then fast enough to feel the blood run into your hand. (about 30 revolutions.

(b) Same process on left hand.

(c) Place feet together and swing both hands at the same time. Palms should slap as they both come in front of your body.
Upper arm stretch

upper arm, shoulder

Place right arm over shoulder, palm down on back. Left hand is then placed on elbow of right arm, forcing it gently back. Reverse for other arm.
Side stretch

muscles on side of trunk

Place left hand on right ear so that inside of left elbow is on the top of your head. Feet shoulder width apart. Right hand should be placed as far down right side as possible. (below knee and close to ankle) Reverse for other side.
Arm and Shoulder Stretch

Inside of elbow, inside of upper arm, shoulder.

Place palms of hands facing each other so that the fingertips of one hand touch the bottom of the fingers of the other hand. Press against each other until wrists are least level.
Wrist extension

inside of forearm and wrist

Stand at a 90° angle to a wall, with right side against wall. Place right arm straight back with palm against wall and elbow locked. Rotate body away from wall. Repeat with palm away from wall. Reverse for other arm.
Neck rotation

muscles on all sides of neck

Rotate neck gently in a circular manner. Both ways.
On Your Back

*Lower Back*

Lie down on your back with the small of your back on the floor. Bring your knee back towards your shoulder with your knee bent. Hold for 10 seconds. Repeat on other side. Bring both legs up together and hold for 10 seconds.
Butterfly

*Inside of Upper Thigh*

Sit down with the bottom of feet against each other. Place the heels of your feet as close to your body as possible. Lean back, placing hands palm down behind you. Lower knees slowly until they reach the ground simultaneously.
Butterfly

_Lower Back_

Seated in same position, now place hands around toes or ankles and bring forehead to toes.
Butterfly

*Middle and Lower Back*

Place arms around legs (in same position so that inside of elbows are on the foot side of the knee. Hands come underneath calves and join near the heels of your feet. Push out with the legs forcing the arms to pull the back, stretching the muscles in middle and lower part.
Trunk Twist

*Stretches trunk and lower back*

Sit in a half lotus (or lotus if you can) and rotate shoulders and trunk so that you face the other direction. Reverse for other side.

With feet shoulderwidth apart, swing arms slowly from front to back (side to side), stretching trunk slowly.
Over on Back

*Neck*

Bend knees and place them on floor next to ears.
One Leg Up, One Back

*Outside of buttock*

Place left leg in front of you at right angle. Outside of knee and ankle will be touching the floor. Right leg is behind you with knee cap and top of foot on floor. Lean down to left leg, then over to left foot, then arch back as far as you can, then reverse process on other leg.
One Leg Out

*Side of Body and Lower Back (on sides)*

From a butterfly position, place left leg out in front with the knee locked. Grab the left ankle with the hand and bringing the right shoulder back parallel to the left, pull the left shoulder toward the left knee. Hold for 10 seconds, and repeat on opposite side.
Legs Together

Back of Legs from Below Knee to Lower Back.  
Also Middle Back.

(1) Sit down and place both legs flat on the ground with knees locked. Toes are pointed up and pulled back toward your chest. Insides of knees are together.  (2) Place your hands on your feet and bring face to knees. Hold for at least 10 seconds. Repeat a minimum of 5 times.
Hang

Back of legs from below knee to lower back

Place feet together and, keeping knees locked, place hands on ankles and bring face to knees. 10 seconds. Minimum of 5.
Squat (side to side)

*Inside of upper thigh, calf*

(1) Sit in a squat. (2) Throw your right leg out and shift your weight on to it. Both feet must remain flat and left leg locked. (3) Reverse and continue at fairly rapid pace.
Hurdler

Back of Leg

(1) Sit on floor with left leg extended in front of you, knee locked and toes pointed up and pulled in. (2) Place right leg at $90^\circ$ angle to left, with inside of knee and ankle on floor. (3) Place hands around left ankle and bring face to left knee, keeping knee locked.
Hurdler

Front of Thigh

(4) Then, releasing ankle, lean back, putting weight first on elbows and then all the way to shoulders. Keep right knee on floor. Reverse process.
Side-Split

*Inside of upper thigh*

(1) Split legs sideways as far as is comfortably possible. (2) Place hands on ground in front of you, now split legs farther apart. (3) Continue until limit is reached. Do for at least 12 minutes.
Leg Spread

*Back of Legs from Knee to Lower Back; also Middle Back*

(1) Sit down and spread legs as comfortable as possible, keeping knees straight. Foot should be pointed up with toes pulled back towards body. (2) Place palm side of right hand on the outside of the left ankle and gently lower your head to your left knee. Hold in that position (as close to your knee as you can; this may not be very close at all, but with continued effort it can be achieved) for as long as 10 seconds. (3) Release, and follow same procedure on other leg. Place left hand on left ankle and right hand on right ankle and pull face towards floor in front of you. Remember knees must stay locked at all times.
Over On Back

Small of Back, Back

(1) Lie down on back with arms straight out from body, palms down. (2) Keeping knees locked and toes pointed out, bring feet over head and touch on ground above head. (3) Walk with toes about six inches at a time to right hand then all the way back to the left hand.
Front Leg Bent Back Straight

Groin Area

(1) Bend right leg to 90°, with left leg straight back. (2) Drop hip to stretch groin; reverse for other leg.
Knee Rotation

Loosens up knees

Place feet shoulderwidth apart with hands on knees. Rotate knees in large, circular motion. Reverse motion.
One Foot Upon Chest

Outside of upper thigh

(1) In seated position with left leg straight out in front of you, bring right foot so that sole of shoe is flat against chest. (2) Reverse process for other leg.
Ankle Rotation

*Inside, outside, front and back of ankle*

Sit with one leg in front (straight), the other bent with foot in hands. Rotate ankle slowly. Reverse.

Standing on all fours with 2/3 weight on hands, rotate ankles first inward, then outward.
Calf Stretch

Back of Lower Leg

(1) Stand with hands against wall and feet about three or four feet away. Put left toes on right heel. (2) Drop waist slowly toward floor, keeping heel on floor. Repeat exercise with right toes on left heels.
Upper Arm Stretch

*Upper Arm, Shoulder*

(1) Place right arm over shoulder, palm down on back. (2) Left hand is then placed on elbow of right arm, forcing it gently back. (3) Reverse for other arm.
Side Stretch

*Muscles on side of trunk*

(1) Place left hand on right ear so that inside of left elbow is on the top of your head. (2) Place feet shoulder width apart. (3) Right hand should be placed as far down right side as possible (below knee and close to ankle). (4) Reverse for other side.
Wrist Extension

Inside of forearm and wrist

(1) Place palms of hands facing each other so that the fingertips of one hand touch the bottom of the fingers of the other hand. (2) Press against each other until wrists are at least level.
Arm and Shoulder

Inside of elbow, inside of upper arm, shoulder.

Stand with left side against wall. Place right arm straight back with palm against wall and elbow locked. Repeat with palm away from wall. Reverse for other arm.
APPENDIX D: TIMED-X: UPPER BODY EXERCISE DIAGRAMS

Push-Ups

Elbows in

Elbows out

Triangles

Chest

Shoulders and Arms

Shoulder, Neck, and Triceps

Keep the inside of the upper arm against the sides. Touch the chest going down and lock out the elbows coming up.

Keep the elbows pointing away from the sides of the body. Touch the chest going down and lock out the elbows coming up.

Place the hands forming a triangle in front of the body. When the body is lowered, the forehead should land inside the triangle with the abdomen touching the ground at the same time. (If the lower back is weak or begins to hurt, spread legs while doing the triangle exercise.) Lock out the elbows coming up.
Hand stand push-ups

Shoulders and Arms

Stand on your hands with feet balancing against the wall. (back to wall) Lower the body until the nose touches the ground and extend up until the elbows are completely locked.
Pull-Ups

Back, Shoulders, and Arms

Hang from a bar or doorway with palms facing away from the body. (Feet must be off the ground.) Pull up until the chin is over the bar or top of door.
Curl-Ups

Abdominal Area

Lying on your back with knees bent and feet flat on the floor, curl up to a seated position. Wrists should be across chest if possible. The last area to leave the ground will be the small of the back.
Double-Ups

Keeping feet six inches off the ground and the arms on the mid-section, bring knees (bent) to the chest and the chest to the knees. Extend out again touching shoulders down and locking out the knees while keeping the feet from touching the ground.
While lying on back in a completely extended position, raise the feet 6 inches off the ground. Without bending the elbows or the knees, bring the shoulders and legs up until the fingers touch the toes. Extend back out without letting the feet touch the ground.
Up and Out

Abdominal Area

Lying on back with arms out, lift legs up, pointing towards the ceiling, bend knees and extend legs out to starting position. The small of the back should always be on the ground and the motion should be continuous. Legs should not touch ground until exercise period is over.
Spread Eagle

Abdominal and Inside of Upper Leg.

While lying on back with arms and legs completely spread, lift arms and legs 6 inches off ground and hold.
Calves Across Chair

Abdominals

Place legs (lower) across a chair while lying on back. With wrists across the chest curl up. The last area to leave the ground should be the small of the back.
Roman Chairs

Abdominals (particularly the sides.)

Sit on a chair with the back to the side. Hook toes under something. Lean back until back is parallel with the floor. Rotate at the waist to one side and then back to parallel position and up. Repeat going to opposite side.
Squat Thrusts

Overall Body

From a standing position, squat to all fours. Extend legs back and assume a push-up position. Bring legs back to squat and return to standing position with the hands on the hips. Keep the back as straight as possible from the standing to the squatting position.
Running in Place

Legs

Run in place, bringing the knees at least waist high.
Jumping Jacks

Overall Body

Touch hands when legs are apart and bring arms to sides when feet are together.
Jump as high as possible, reaching into the air with both hands.
Kangaroo Hops

Legs

Jump as high as possible and bring the knees up until they touch the chest. Jump again as soon as you land. Cushion the landing by bending the knees slightly upon contact.
Mountain Climber

Legs

From kneeling position, bring one knee up followed by the other to a now squatting position. Lower opposite leg. Return to starting position.
Treadmill I

Legs

Start in sprinter stretch position. Move feet back and forth with knees inside elbows. Front foot should touch ground.
Treadmill II

Legs and Hips

Start in sprinter stretch position and move feet back and forth with the heel of the foot touching the ground next to the hand on the same side. Make sure that the heel is down and the toe up and that the heel is all the way up next to the hand.
Sidewinder I

Upper Leg and Hip

Lie on your side with your legs extended. Place bottom arm out in front for balance. Lift your leg as high to the side as you can, maintaining a direct line from shoulder to foot.
Sidewinder II

Upper Leg and Hip.
Arm and Shoulder.

Supporting your weight on your arm, lift your leg as high as possible keeping a straight line from shoulder to foot.
Hip Swivel
Overall Body

Start in a seated position with one foot underneath you and the other leg pointed out straight towards the wall. Lift up the leg that is out and while placing down the other hand, rotate the hips. Place down the foot of the leg that was out so that now you are in a squat position on all fours. Push out the opposite leg to the other side and now face the opposite wall. You should be close to the ground but not seated.
Crab Kick

Overall body (Arms)

From a crab walk position, jump, touching the right hand to the left toe. Without touching the ground, jump and switch so that the left hand touches the right toe and the right hand and left foot are on the ground. *Note that this takes a lot of arm and wrist strength.
Jump as high as possible and lift your legs up spreading as far as possible with the knees locked. Touch the toes with the hands. Cushion the fall by bending the knees slightly upon contact.
APPENDIX G: TIMED-X: UPPER BODY EXERCISE PICTURES

Push-Ups (elbows in)

_Chest_

Keep the inside of the upper arm against the sides. Touch the chest to the floor going down and lock the elbows coming up.
Push-Ups (elbows out)

Shoulders and Arms

Keep the elbows pointing away from the sides of the body. Touch the chest to the floor going down (see next page). Lock the elbows coming up.
Triangles

Shoulder, Neck and Triceps

Place the hands together forming a triangle with the index fingers and thumbs. When the body is lowered, the forehead should land inside the triangle with the abdomen touching the ground at the same time. (If the lower back is weak or begins to hurt, spread legs while doing the triangle exercise.) Lock the elbows coming up.
Handstand Push-Ups

Shoulders and Arms

Stand on your hands with feet balancing against the wall (back to wall). Lower the body until the nose touches the ground and extend up until the elbows are completely locked.
Curl-Ups

*Abdominal Area*

Lying on your back with knees bent and feet flat on the floor curl up to a seated position. Wrists should be across chest if possible. The last area to leave the ground will be the small of the back.
Double-Ups

Abdominal area

(1) Keeping feet six inches off the ground and the arms on the mid-section, bring knees (bent) to the chest and the chest to the knees.
(2) Extend out again, touching shoulders down and locking the knees while keeping the feet from touching the ground.
Nip-Ups

Abdominal area

(1) While lying on back in a completely extended position, raise the feet 6 inches off the ground. (2) Without bending the elbows or the knees, bring the shoulder and legs up until the fingers touch the toes. (3) Extend back out without letting the feet touch the ground.
(1) Lying on back with arms out, lift legs up, pointing towards the ceiling. (2) Bend knees and then extend legs out to starting position. The small of the back should always be on the ground and the motion should be continuous. Legs should not touch ground until exercise period is over.
Spread Eagle

Abdominal and Inside of Upper Leg

While lying on back with arms and legs completely spread, lift arms and legs 6 inches off the ground and hold.
Calves Across Chair

Abdominals

(1) Place lower legs across a chair while lying on back. (2) With wrists across the chest curl up. (3) The last area to leave the ground should be the small of the back.
Roman Chairs

**Abdominals**
*(particularly the sides.)*

1. Sit on a chair with the back to the side. Hook toes under something.
2. Lean back until back is parallel with the floor.
3. Rotate at the waist to one side and then back to parallel position and up. (See next page.)
4. Repeat, going to opposite side.
Squat Thrusts

*Overall body*

(1) From a standing position, squat to all fours. (2) Extend legs back and assume a push-up position. (3) Bring legs back to squat and return to standing position with the hands on the hips. Keep the back as straight as possible from the standing to the squatting position.
Running In Place

Legs

Run in place, bringing the knees at least waist high.
Jumping Jacks

Overall Body

Touch hands when legs are apart and bring arms to sides when feet are together.
Jumping Jacks

*Overall Body*

Touch hands when legs are apart and bring arms to sides when feet are together.
Jumping

Legs

Jump as high as possible, reaching into the air with both hands.
Kangaroo Hops

*Legs*

Jump as high as possible and bring the knees up until they touch the chest. Jump again as soon as you land. Cushion the landing by bending the knees slightly upon contact.
Mountain Climber

Legs

From kneeling position, bring one knee up, followed by the other to a now squatting position. Lower opposite leg. Return to starting position. Do as fast as possible.
Treadmill I

Legs

(1) Begin in sprinter stretch position -- leaning forward along floor, upper body weight resting on fingertips or hands, left knee up under chest, right leg extended back.  (2) Keeping fingertips on floor, jump slightly so that right and left legs can change positions.  (3) Repeat. Always keep knees next to elbows.
Treadmill

Legs and Hips

(1) Begin in sprinter stretch position, but this time place the left foot on the floor outside the left hand, toes point up. (2) Keeping hands on floor, jump slightly so that right and left legs can change positions.
Sidewinder I

*Upper Leg and Hip*

Lie on your side with your legs extended. Place bottom arm out in front for balance. Lift your leg as high to the side as you can, maintaining a direct line from shoulder to foot.
Sidewinder II (left)

*Upper leg and hip, arm and shoulder*

Supporting your weight on your left arm, lift your leg as high as possible, keeping a straight line from shoulder to bottom foot. Throw leg up hard and set it down easy.
Sidewinder II (right)

Upper Leg and Hip Arm and Shoulder

Supporting your weight on your right arm, lift your leg as high as possible, keeping a straight line from shoulder to bottom foot. Throw leg up hard and set it down easy.
Hip Swivel

Overall body

(1) Begin on hands and knees, then put weight on hands and feet. (2) Shift weight to left hand and right foot. (3) Bring left foot under the body until it points to the wall at your right; at the same time lift your right hand. (4) As your foot passes under you, lean back until you are in a squatting position over the right foot, with your left hand still on the floor for balance. (5) Return to original position on hands and feet, then repeat with the weight on right hand and left foot, and the right foot passing under your body to point to the opposite wall.
Russian Toe Jumps

Legs and Overall Body

Jump as high as possible and lift your legs up, spreading as far as possible with the knees locked. Touch the toes with the hands. Cushion the fall by bending the knees slightly upon contact.
APPENDIX J: COOPER'S FITNESS CATEGORIES
1.5 Mile Run Test
Men: Age 19 Years

<table>
<thead>
<tr>
<th>Fitness Category</th>
<th>Minutes:Seconds</th>
</tr>
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<tbody>
<tr>
<td>I. Very Poor</td>
<td>&gt; 15:31</td>
</tr>
<tr>
<td>II. Poor</td>
<td>12:11-15:30</td>
</tr>
<tr>
<td>III. Fair</td>
<td>10:49-12:10</td>
</tr>
<tr>
<td>IV. Good</td>
<td>9:41-10:48</td>
</tr>
<tr>
<td>V. Excellent</td>
<td>8:37- 9:40</td>
</tr>
<tr>
<td>VI. Superior</td>
<td>&lt;8:37</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


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86. Wight, Harry. Principal, Moroni High School. Interview.
